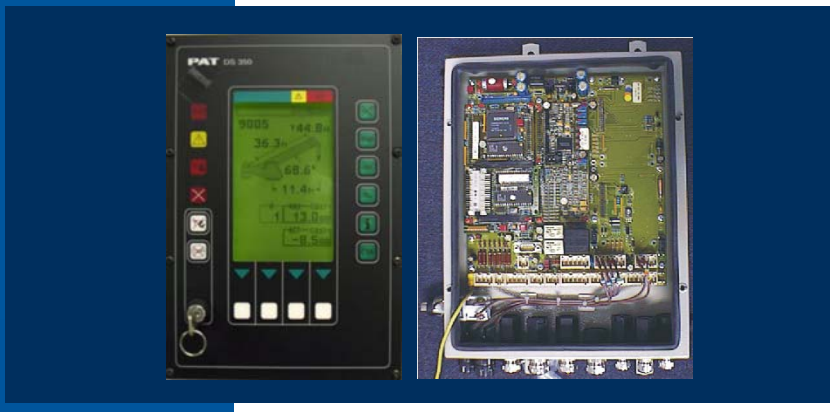
SkyAzúl
EQUIPMENT SOLUTIONS

DS350GM



SERVICE MANUAL

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1 GENERAL INFORMATION

This troubleshooting manual is designed to assist a service or maintenance person in identifying system problem areas or malfunctions. A digital voltmeter with the capability to also measure current will be required. Regular maintenance and service tools will also be required. NOTE: Knowledge of how to use a voltmeter to measure both voltage and current is assumed.

REFERENCE:
For system operation, refer to the operator's manual for the console. This may differ from crane manufacturer and model.

Section 3.1 is a general flow chart that directs you to detailed flow charts and sections.
Section 3.2 provides a list of error codes, error, cause, and possible action for the error.
Sections 3.3 – 3.11 provide detailed flow charts to define and correct the root cause.
Section 4 provides drawings that will be referenced for troubleshooting.
Section 5 provides procedures that will be referenced for troubleshooting.
Section 6 provides drawings for the theory of operation of all the different sensing devices used in the DS350G Modular System. Use these reference drawings to better understand the operation of the system.

2 WARNINGS

The LMI is an operational aid that warns a crane operator of approaching overload conditions and overhoist conditions that could cause damage to equipment and personnel. Therefore, the device is not, and shall not be, a substitute for good operator judgment, experience and use of accepted safe crane operating procedures.

The responsibility for the safe crane operation shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.

Prior to operating the crane, the operator must carefully and thoroughly read and understand the information in the crane's operating manuals to ensure that the operator knows the operation and limitations of indicator and crane.

PAT Load Moment Indicator (LMI) DS 350 Modular

The PAT Load Moment Indicator (LMI) DS 350 Modular has been designed to provide the crane operator with the essential information required to operate the machine within the designed parameters. Using different sensing devices, the DS 350 Modular LMI monitors various crane functions and provides the operator with a continuous display of the crane's capacity. The display continually changes as the crane moves through the motions needed to make a lift.

If non-permitted conditions are approached, the DS 350 LMI will warn the operator by sounding an audible alarm and lighting a warning light. In addition the LMI system has the capability to provide a signal to the solenoids and thereby locking out those functions that may aggravate the crane's condition.

3 FLOWCHARTS

3.1 GENERAL FLOWCHART

This section explains how to handle a problem that may arise with the PAT DS 350 Modular LMI. The procedures are given in flowchart format for the following sections. Start with the general flowchart below that will guide you to one of the detailed flowcharts shown in this section. The drawings and procedures that are referenced in these sections can be found in Sections 4 and 5.

3.2 ERROR CODE DISPLAY

PROBLEM: Error code displayed. Lever lockout activated. Warning lights on.

ERROR CODE	ERROR	CAUSE	ACTION
E01	Minimum radius or maximum angle range exceeded	Fallen below the minimum radius or above the angle given in the load chart due to raising the boom to far.	Lower boom back to a radius or angle given in the load chart.
E02	Maximum radius or minimum angle range exceeded	The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.	Raise boom back to a radius or angle given in the load chart.
E03	Prohibited slewing range (no load area)	Slewing range prohibited with load.	Slew back into admissible range.
E04	Operating mode not available	Operating mode switch in the console set incorrectly. Operating mode is not permissible with actual crane configuration.	Set operating mode switch correctly to the code assigned to the operating mode of the crane.
E05	Length range not permitted	Boom has been extended too far or not far enough. Length sensor adjustment changed; i.e. length sensor cable slid off the cable drum.	Refer to Section 3.7. Retract or extend boom to correct length given in the load chart.
E06	Fallen below angle range with luffing jib operation.	Fallen below the minimum jib angle specified n the respective load chart due to luffing out the jib too far.	Luff in the jib to a radius or angle specified in the load chart.
E07	No acknowledgment signal from overload relay (K1).	Overload relay is stuck, defective or not being selected.	Replace main board in central unit. Refer to Drawing 4 and Procedure 3 in Section 5.3
E08	No acknowledgment signal from Anti-Two-Block switch relay (K2).	Anti-Two-Block switch relay is defective or not being selected.	Replace main board in central unit. Refer to Drawing 4, Section 4.4, and Procedure 3 in Section 5.3.
E10	Error in length measurement	With the boom fully retracted, the length differs by more than 2%.	Refer to Section 3.7.

ERROR CODE	ERROR	CAUSE	ACTION
E11	Fallen below limit for the measuring channel “length”.	a.) Cable between length sensor and central unit defective, not connected or water in the connectors. b.)Length sensor Potentiometer defective. c.)Electronic board in the measuring channel defective.	Refer to Section 3.7 a.)Check cable and connector b.) Check and reset length sensor Potentiometer. Refer to Procedure 5. c.) Check signal on main board and analog input module.
E12	Fallen below lower limit value for the measuring channel “pressure transducer piston side”.	a.) Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Pressure transducer on piston side defective. c.)Electronic component in the measuring channel defective.	Refer to Section 3.9 a.)Check cable and connector b.)Check pressure transducer and reset pressure channel. c.) Check signal on main board and analog input module.
E13	Fallen below lower limit value for the measuring channel “pressure transducer rod side”.	a.)Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Pressure transducer on rod side defective. c.)Electronic component in the measuring channel defective.	Refer to Section 3.9 a.)Check cable and connector b.) Check pressure transducer and reset pressure channel. c.) Check signal on main board and analog input module.
E14	Fallen below lower limit value for the measuring channel “force”.	a.)Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Force transducer defective. c.)Electronic component in the measuring channel defective.	a.) Check cable and connectors as well and replace, if necessary. b.)Check force transducer. c.) Check signal on main board and analog input module.
E 15	Fallen below lower limit value for the measuring channel “angle main boom”.	a.)Cable from central unit to the length/angle sensor defective or loose. b.)Angle sensor defective. c.)Electronic component in the measuring channel defective.	Refer to Section 3.8 a.) Check cable. b.) Check angle sensor and reset adjustment. Refer to Procedure 5 c.) Check signal on main board and analog input module.

ERROR CODE	ERROR	CAUSE	ACTION
E16	Fallen below lower limit value for measuring channel “Luffing Jib Angle”.	a.)Cable from central unit to angle sensor defective or disconnected or water inside the plug. b.)Angle sensor defective. c.)Electronic component in the measuring channel defective.	a.) Check cable. b.) Check angle sensor and reset adjustment. c.) Check signal on main board and analog input module.
E17	Fallen below lower limit value for the measuring channel 7.	a.)Cable leading from the central unit to the sensor of channel 7 defective, loose or water in the connectors. b.)Sensor of channel 7 defective. c.)Electronic component in the measuring channel 7 defective.	a.) Check cable and connectors. b.) Check sensor of channel 7 and reset adjustment. c.) Check signal on main board and analog input module.
E18	Outrigger overloaded	Front outrigger overloaded	Check outrigger sensor
E19	Error in the reference voltage.	Electronic component on the main board defective.	Replace main board. Refer to Drawing 4 and Procedure 3.
E1A E1B	Below limiting value for slewing angle 1. Below limiting value for slewing angle 2.	a.)Cable from central unit to the slewing angle sensor defective or loose. b.)Slewing angle potentiometer defective. c.)Electronic component in the measuring channel defective on main board.	a.) Check cable. b.) Check and reset slewing angle potentiometer. c.) Check signal on main board and analog input module.
E21	Upper limiting value for the measuring channel “length” exceeded.	a.)Cable from central unit to the length/angle sensor defective or loose. b.)Length potentiometer defective. c.)Electronic component in the measuring channel defective on main board.	Refer to Section 3.7 a.) Check cable and connector b.) Check and reset length sensor Potentiometer. Refer to Procedure 5. c.) Check signal on main board and analog input module.

ERROR CODE	ERROR	CAUSE	ACTION
E22	Upper limiting value for the measuring channel “pressure piston side” exceeded.	a.)Cable from central unit to the pressure transducer defective, loose or water in the plug. b.)Pressure transducer on piston side defective. c.)Electronic component in the measuring channel defective on main board.	Refer to Section 3.9 a.) Check cable and connector b.) Check pressure transducer and reset pressure channel. c.) Check signal on main board and analog input module.
E23	Upper limit value for the measuring channel “pressure transducer rod side” exceeded.	a.) Cable lead in from the central unit to press trans defective, not connected or water in the connectors. b.) Pressure transducer on rod side defective. c.) Electronic component in the measuring channel defective.	Refer to Section 3.9 a.) Check cable and connector b.) Check pressure transducer and reset pressure channel. c.) Check signal on main board and analog input module.
E24	Upper limit value for the measuring channel “force” exceeded.	a.) Cable leading from the central unit to the force transducer defective, not connected or water in the connectors. b.) Force transducer defective. c.) Electric component in the measuring channel defective.	a.) Check cable and connectors as well and replace, if necessary. b.) Check force transducer. c.) Check signal on main board and analog input module.
E25	Upper limit value for the measuring channel “angle main boom” exceeded.	a.) Cable leading from the central unit to the length/angle sensor defective, loose or water in the connectors. b.) Angle sensor defective c.) Electronic component in the measuring channel defective.	Refer to Section 3.8 a.) Check cable. b.) Check angle sensor and reset adjustment. Refer to Procedure 5 c.) Check signal on main board and analog input module.
E26	Upper limit value for the measuring channel “Luffing Jib Angle” exceeded.	a.) Cable leading from the central unit to the jib angle sensor defective, loose or water in the connectors. b.) Jib angle sensor defective. c.) Electronic component in the measuring channel defective.	a.) Check cable. b.) Check angle sensor and reset adjustment. c.) Check signal on main board and analog input module.

ERROR CODE	ERROR	CAUSE	ACTION
E27	Upper limit value for the measuring channel 7 exceeded.	a.) Cable leading from the central unit to the sensor of channel 7 defective, loose or water in the connectors. b.) Sensor of channel 7 defective. c.) Electronic component in the measuring channel 7 defective.	a.) Check cable and connectors. b.) Check sensor of channel 7 and reset adjustment. c.) Check signal on main board and analog input module.
E29	Reference voltage defective.	a.) The total of the supply and the reference voltages on MP10 is more than 3.3V b.) A/D converter defective.	a.) Check supply voltages. b.) Replace main board or analog input module. Refer to Drawing 4 and Procedure 3 Steps 1,2,4, 11,12..
E2A E2B	Above limiting value for slewing angle 1. Above limiting value for slewing angle 2.	a.)Cable from central unit to the slewing angle sensor defective or loose. b.)Slewing angle potentiometer defective. c.)Electronic component in the measuring channel defective on main board.	a.) Check cable. b.) Check and reset slewing angle potentiometer. c.) Check signal on main board and analog input module.
E31	Error in the system program.	a.) EPROM with system program defective. b.) Electronic component on the main board defective.	a.) Replace system program EPROM b.) Check signal on main board and analog input module.
E37	Error in the program run	a.) EPROM with system program defective. b.) Electronic component on the main board defective.	a.) Replace system program EPROM. b.) Check signal on main board and analog input module.
E38	System program and Data EPROM do not match.	The system program in the LMI does not correspond to the programming in the data EPROM	Replace system program EPROM or Data EPROM. Refer to Procedure 2
E39	System program and TLK EPROM do not match.	The system program in the LMI does not correspond to the programming in the data EPROM	Replace system program EPROM or TLK EPROM. Refer to Procedure 2
E41	Error in the external RAM.	Defective electronic component.	Replace main board or analog input module. Refer to Drawing 4 and Procedure 3, Steps 1,2,4, 11, and 12.

ERROR CODE	ERROR	CAUSE	ACTION
E42	Error in the external write/read memory (RAM). Part 1	Internal defect in digital part of CPU.	Exchange write/read memory (CMOS-RAM). Replace CPU module. Refer to Drawing 4 and Procedure 3, Steps 1-3, 13,14.
E43	Error in the external write/read memory (RAM). Part 2.	Internal defect in digital part of CPU.	Exchange write/read memory (CMOS-RAM). Replace CPU module. Refer to Drawing 4 and Procedure 3, Steps 1-3, 13,14.
E45	Redundancy error in A/D conversion.	Defective electronic component.	Replace analog input module. Refer to Drawing 4 and Procedure 3, Steps 1,2,4, 11,12.
E46	Error in A/D conversion.	Defective electronic component.	Replace analog input module. Refer to Drawing 4 and Procedure 3 Steps 1,2,4, 11,12.
E47	Malfunction in the monitored write/read memory.	Internal defect in digital part of CPU	Replace CPU module. Refer to Drawing 4 and Procedure 3 Steps 1-3, 13,14
E48	Cyclic RAM test: Error in the internal write/read memory.	Internal defect in digital part of CPU	Replace CPU module. Refer to Drawing 4 and Procedure 3 Steps 1-3, 13,14
E51	Error in data EPROM.	EPROM Module not bridged correctly Data EPROM on the main board defective.	Replace Data EPROM. Make sure BR3 on the main board is installed. Refer to Procedure 2.
E52	Error in load chart EPROM.	EPROM Module not bridged correctly Data EPROM on the main board defective.	Replace EPROM Module and reset pressure channels. Refer to Drawing 4 and Procedure 4.
E56	Error in crane data EEPROM.	Memory module wrongly bridged. Crane data EEPROM defective	Bridge memory module acc. To memory type Replace crane data EEPROM Replace EPROM Module and reset pressure channels. Refer to Drawing 4 and Procedure 4.

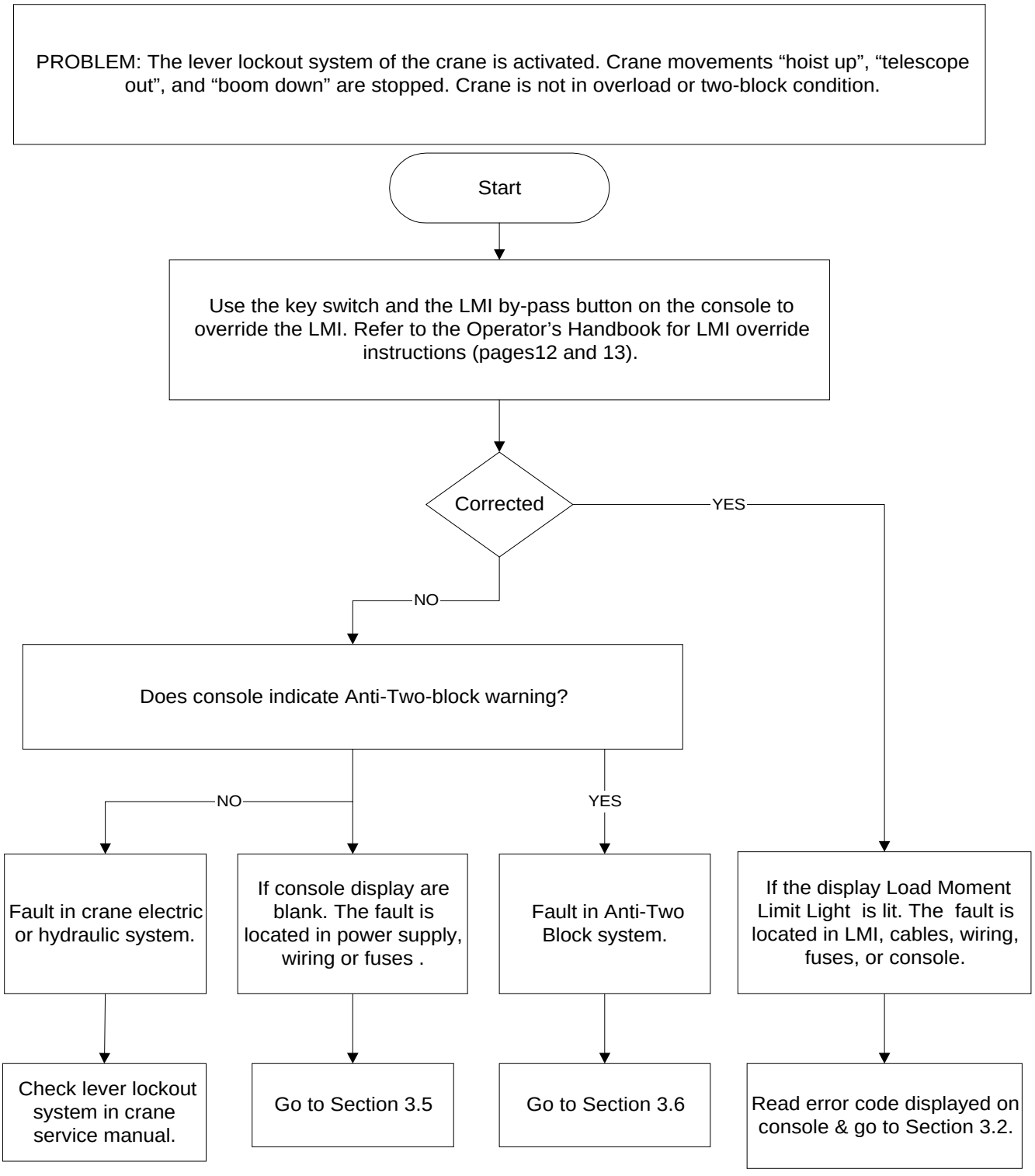
ERROR CODE	ERROR	CAUSE	ACTION
E57	Error in serial crane data EEPROM.	Serial crane data EEPROM does not contain valid data. Memory module defective	Write data on the serial crane data EEPROM (by means of test program or on-line function), then restart the LMI Replace EPROM Module and reset pressure channels. Refer to Drawing 4 and Procedure 4.
E58	Error in the serial analog data EEPROM.	No valid data in the serial analog data EEPROM. LMI main board defective.	Write data on the serial analog data EEPROM by means of the test program, then, restart the LMI Replace LMI main board.
E69	Error in the load chart EPROM The number of the selected EPROM base and the programmed value are not identical	Memory module wrongly bridged Load chart EPROM defective	Bridge memory module acc. to memory type Replace load chart EPROM
E70	Error in digital output module.	Central unit unable to correspond with digital output module.	a.) Check supply voltage. b.) Replace digital output module.
E71	Incorrect acknowledgment of the 1. Relay on the main board.	a.) Anti Two-block relay is stuck or defective. b.) Anti Two-Block relay is not being selected due to a break on the main board.	Replace main board. Refer to Drawing 4 and Procedure 3.
E72 – E77	Analogous to E71 for the relays 2...7.	Analogous to E71 for the relays 2...7.	Analogous to E71 for the relays 2..7.
E84	Wrong rigging condition.	The selected rigging condition is not contained in the data EPROM.	Select another rigging condition Check the programming in the data EPROM.
E85	Error in the radius determination	The computed radius is too small (negative deflection)	Check the programming in the data EPROM.
E89	Change of the operating code during lifting a load.	The operating mode switch in the console was used during lifting a load.	Lower the load and set the operating mode switch correctly to the code assigned to the actual operating mode of the crane.

ERROR CODE	ERROR	CAUSE	ACTION
E 91	No data transmission from console to central unit. (Refer to Section 9)	a.)24V supply of console interrupted. b.)Interruption or accidental ground in the line from console electronics to central unit. c.)Transmitter/receiver module defective.	a.) Check 24V at terminal X1 of console electronics. b.) Check the connection between console electronics and central unit. c.) If accidental ground occurs, the transmitter module in the console electronics can be damaged. Replace the console electronics or main board respectively.
E92	Error in the data transmission from console to central unit. (Refer to also Section 3.10)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.	a.) Check the connection between console electronics and central unit.
E93	Error in the data transmission from central unit to console. (Refer to also Section 3.10)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.	Refer to Section 3.10. a.) Check the connection between console electronics and central unit. b.) Replace console electronics or main board respectively.
E94	No data transmission for central unit to console. (Refer to also Section 3.10)	a.) Interruption or accidental ground in the line from console electronics to central unit. b.) Transmitter/receiver module defective. c.) Data-EPROM defective. d.) CPU defective. e.) Electromagnetic interference (when switching contractors or valves)	Refer to Section 3.10. a.) Check the connection between console electronics and central unit. If you find an accidental ground, the transmitter module in the console electronics can be damaged. Replace the console electronics. b.) Replace console electronics or main board respectively. c.)Check data EPROM. d.) Replace CPU module. Refer to Drawing 4 and Procedure 3 Steps 1-3, 13,14. e.) Eliminate interference source by inverse diodes or varistors.

ERROR CODE	ERROR	CAUSE	ACTION
E95	Error in the crane data EPROM	a.) Data EPROM defective b.) Position of jumper for the selection of the type of EPROM is wrong c.) Electronics component on the main board defective.	a.) Replace data EPROM b.) Check the jumper position c.) Replace CPU module. Refer to Drawing 4 and Procedure 3 Steps 1-3, 13,14
E96	Error in the internal RAM of the CPU of the console	CPU or main board of the console defective	Replace CPU module. Refer to Drawing 4 and Procedure 3 Steps 1-3, 13,14
E97	Error in the external RAM of the CPU of the console	a.) External RAM of the console defective b.) Electronic component on the main board defective.	a.) Replace console main board b.) Replace console main board Refer to Drawing 5.
E98	Wrong jumper position in the console	a.) The jumper position BR 9/BR 10 in the console does not correspond to the actual type of central unit. b.) Electronic component on the main board defective.	a.) Check the jumper position b.) Replace console main board Refer to Drawing 5.
EAB	Short circuit in the A2B switch circuit	Short circuit in the A2B switch Short circuit in the cable to the A2B switch Electronic component on the analog input module defective.	Refer to Section 3.6. Replace A2B switch Replace cable to the A2B switch Check analog input module. Replace if necessary., Refer to Drawing 4 and Procedure 3 Steps 1,2,4, 11,12.

Note:
If an error message is displayed which is not contained in above list, please contact the PAT service department.

3.3 LEVER LOCKOUT ACTIVATED


PROBLEM: The lever lockout system of the crane is activated. Crane movements “hoist up”, “telescope out”, and “boom down” are stopped. Crane is not in overload or two-block condition.
Start
Use the key switch and the LMI by-pass button on the console to override the LMI. Refer to the Operator’s Handbook for LMI override instructions (pages12 and 13).
Corrected
YES
NO
Does console indicate Anti-Two-block warning?
NO
YES
Fault in crane electric or hydraulic system.
If console display are blank. The fault is located in power supply, wiring or fuses .
Fault in Anti-Two Block system.
If the display Load Moment Limit Light is lit. The fault is located in LMI, cables, wiring, fuses, or console.
Check lever lockout system in crane service manual.
Go to Section 3.5
Go to Section 3.6
Read error code displayed on console & go to Section 3.2.

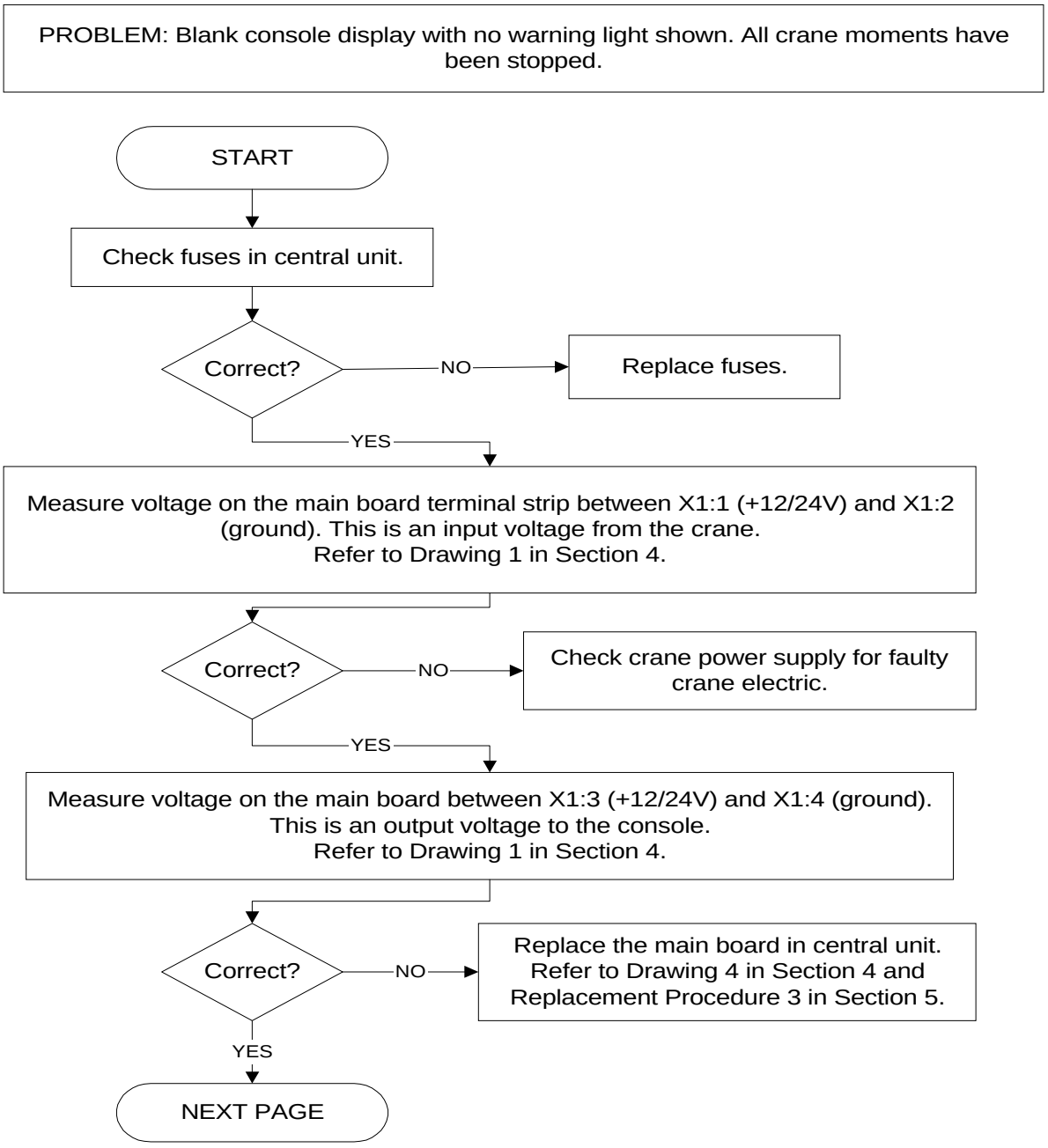
3.4 BROKEN LENGTH CABLE

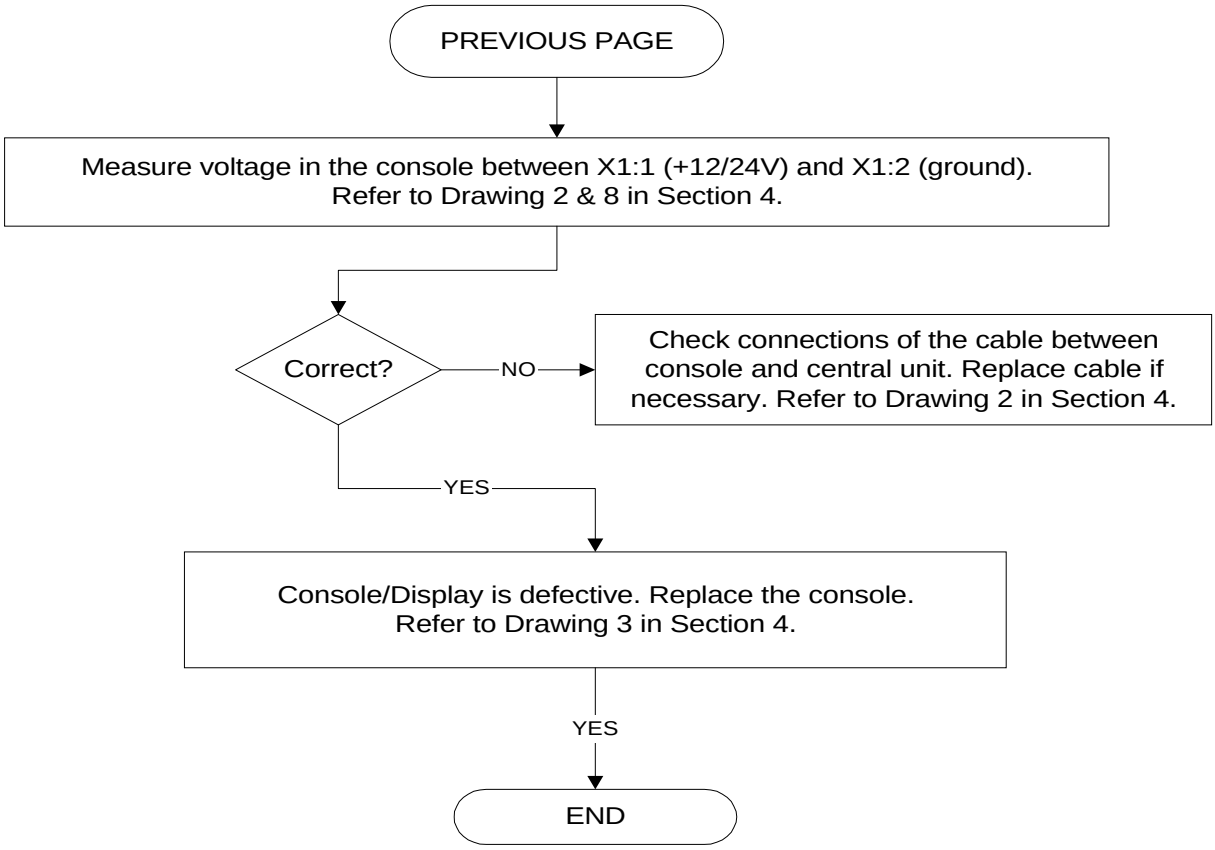
PROBLEM: Damaged or broken length cable.

Replace length cable using the following procedure:
Refer to Section 4 for the following drawings:
Drawing 3 - Electrical Wiring Central Unit to Cable Reel
Drawing 6 - Cable Reel - Parts List

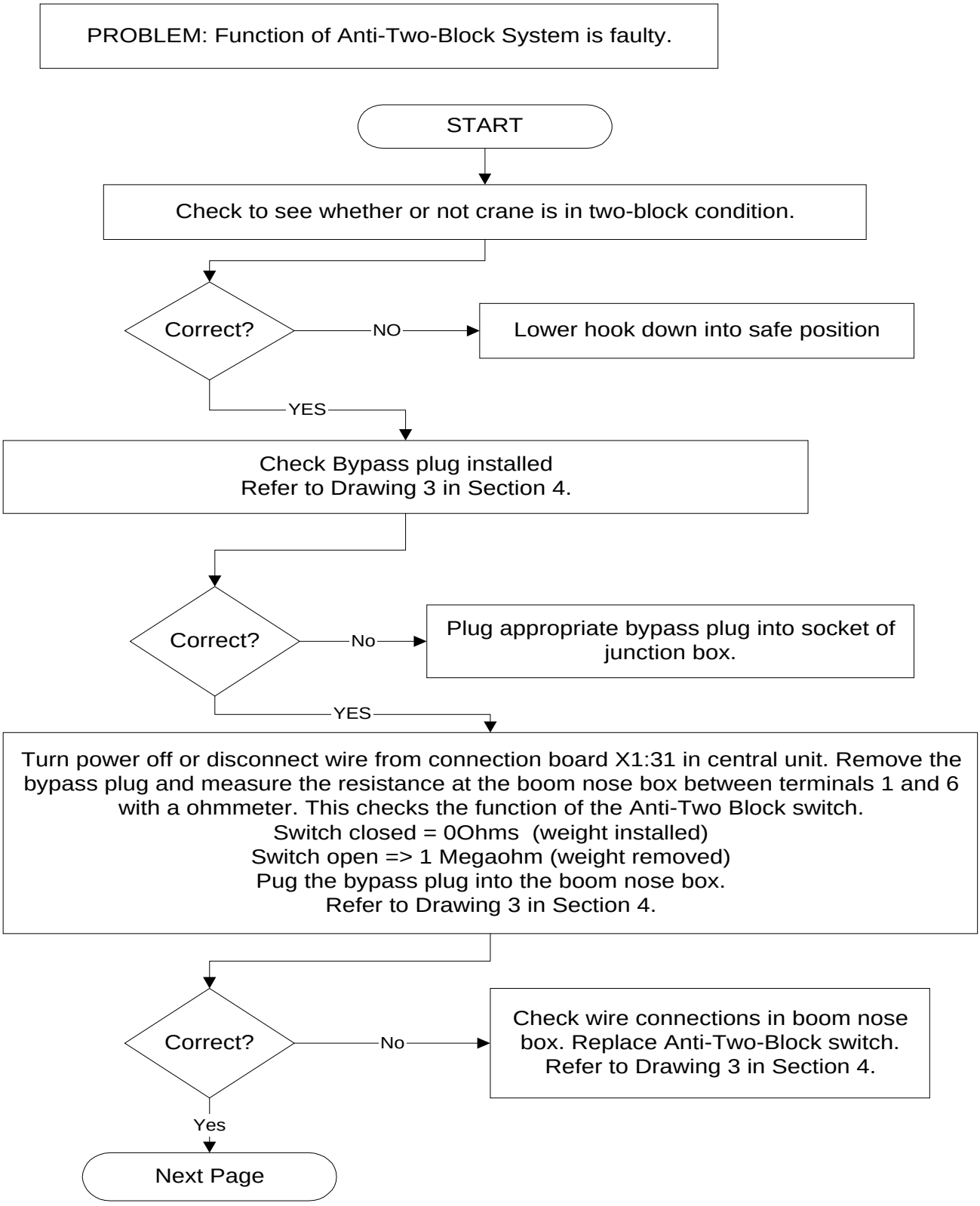
1. Cut old cable at cable drum.
2. Disconnect damaged length cable from junction box at the boom nose. Refer to Drawing 3.
3. Open cable reel cover and disconnect wiring from terminal block. Pull 7 conductor cable out of strain relief. Note: Mark wires to make re-connection simpler.
4. Remove cable reel from mounting brackets.
5. Remove damaged length cable, which is mounted to the slip rings in the cable reel, from slip ring terminal. Refer to Drawing 3.
6. On the back side of the cable reel, open the strain relief attached to the axle in the center of the drum. Pull existing length cable out of the cable reel.
7. Pull new length cable through the hole, pipe and strain relief and push it through the axle of the reeling drum. Tighten new strain relief to ensure sealing.
8. Reconnect the length cable to the slip ring. Refer to Drawing 3.
9. Remount cable reel to the boom.
10. Turn reeling drum clockwise to spool the new cable neatly onto the drum.
11. Set pre-load on cable reel by turning the drum counter-clockwise 5 to 8 turns.
12. Run the new length cable through the cable guides and wrap the length cable around the boom tip anchor pin (4 or 5 wraps) and secure with tie wraps. Leave enough length cable to connect into the boom tip junction box.
13. Connect the length cable into the boom tip junction box. Refer to Drawing 3.
14. Reset length potentiometer in length angle transducer (screw is located in center of white gear); with boom fully retracted, turn potentiometer carefully counter-clockwise until it stops. Recheck length and angle display. Refer to Procedure 5 in Section 5.5.

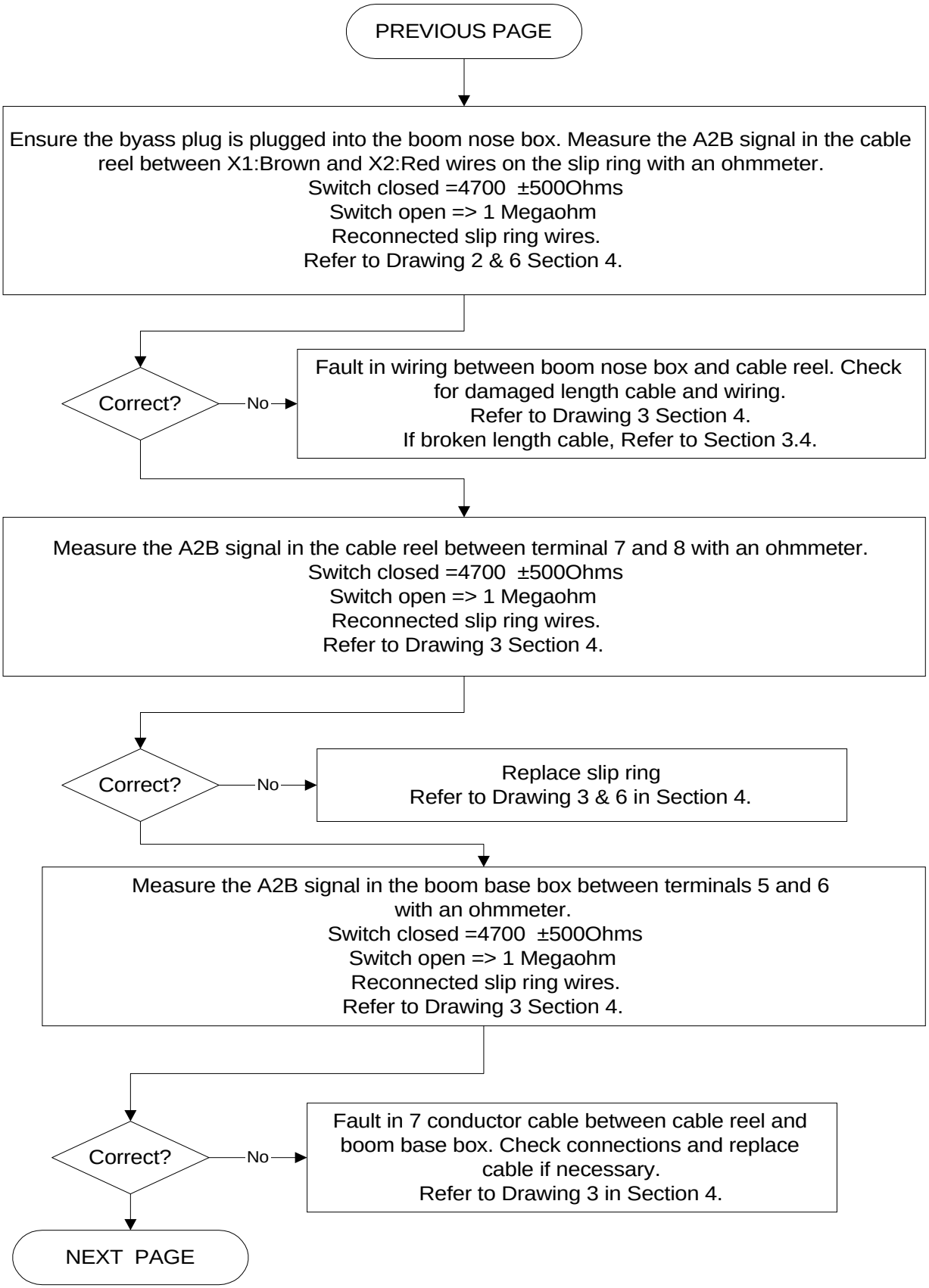
3.5 NO DISPLAY

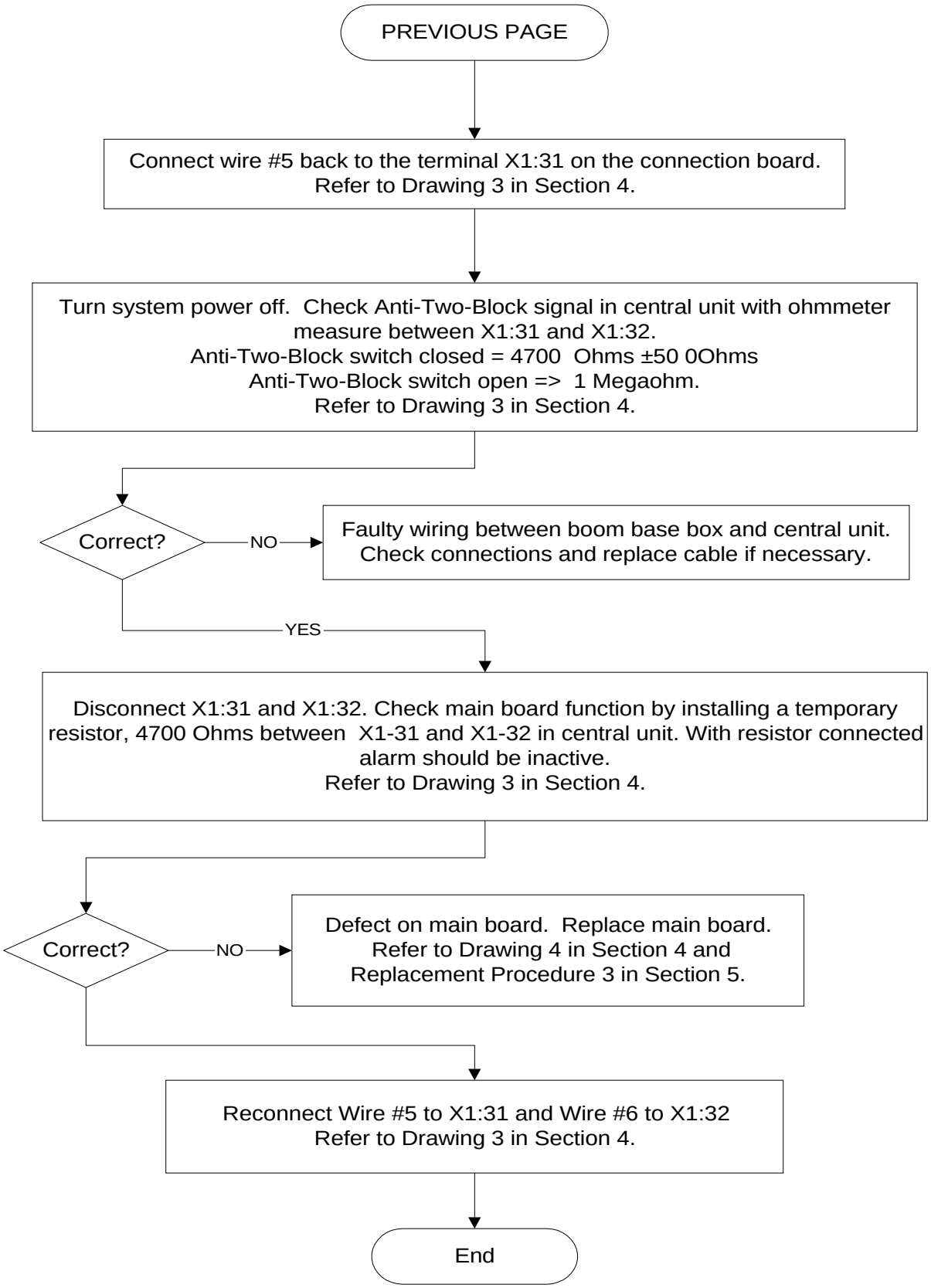

PROBLEM: Blank console display with no warning light shown. All crane moments have been stopped.
START
Check fuses in central unit.
Correct?
NO
Replace fuses.
YES
Measure voltage on the main board terminal strip between X1:1 (+12/24V) and X1:2 (ground). This is an input voltage from the crane.
Refer to Drawing 1 in Section 4.
Correct?
NO
Check crane power supply for faulty crane electric.
YES
Measure voltage on the main board between X1:3 (+12/24V) and X1:4 (ground).
This is an output voltage to the console.
Refer to Drawing 1 in Section 4.
Correct?
NO
Replace the main board in central unit.
Refer to Drawing 4 in Section 4 and
Replacement Procedure 3 in Section 5.
YES
NEXT PAGE


PREVIOUS PAGE
Measure voltage in the console between X1:1 (+12/24V) and X1:2 (ground).
Refer to Drawing 2 & 8 in Section 4.
Correct?
NO
Check connections of the cable between console and central unit. Replace cable if necessary. Refer to Drawing 2 in Section 4.
YES
Console/Display is defective. Replace the console.
Refer to Drawing 3 in Section 4.
YES
END

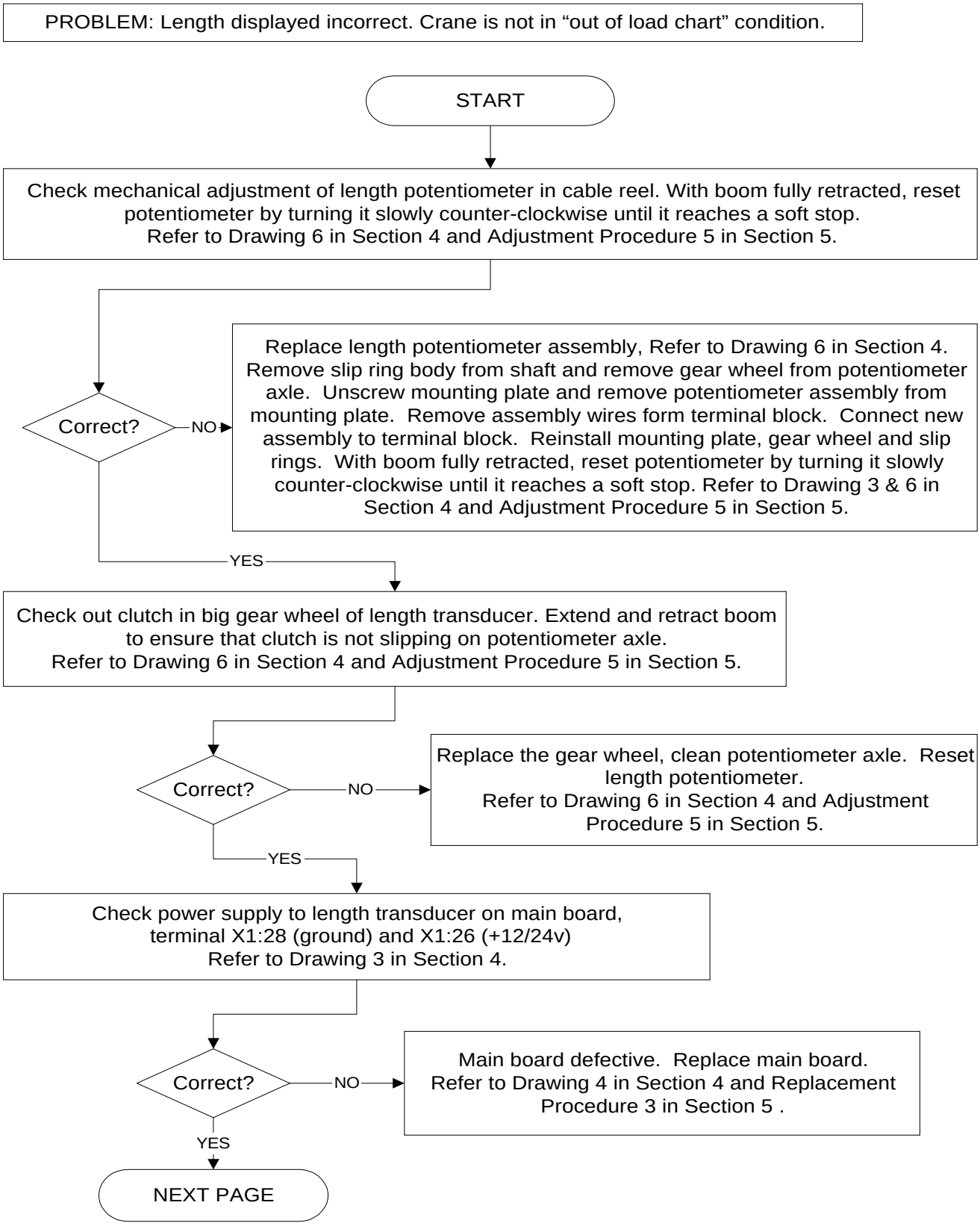
3.6 ANTI-TWO BLOCK PROBLEM

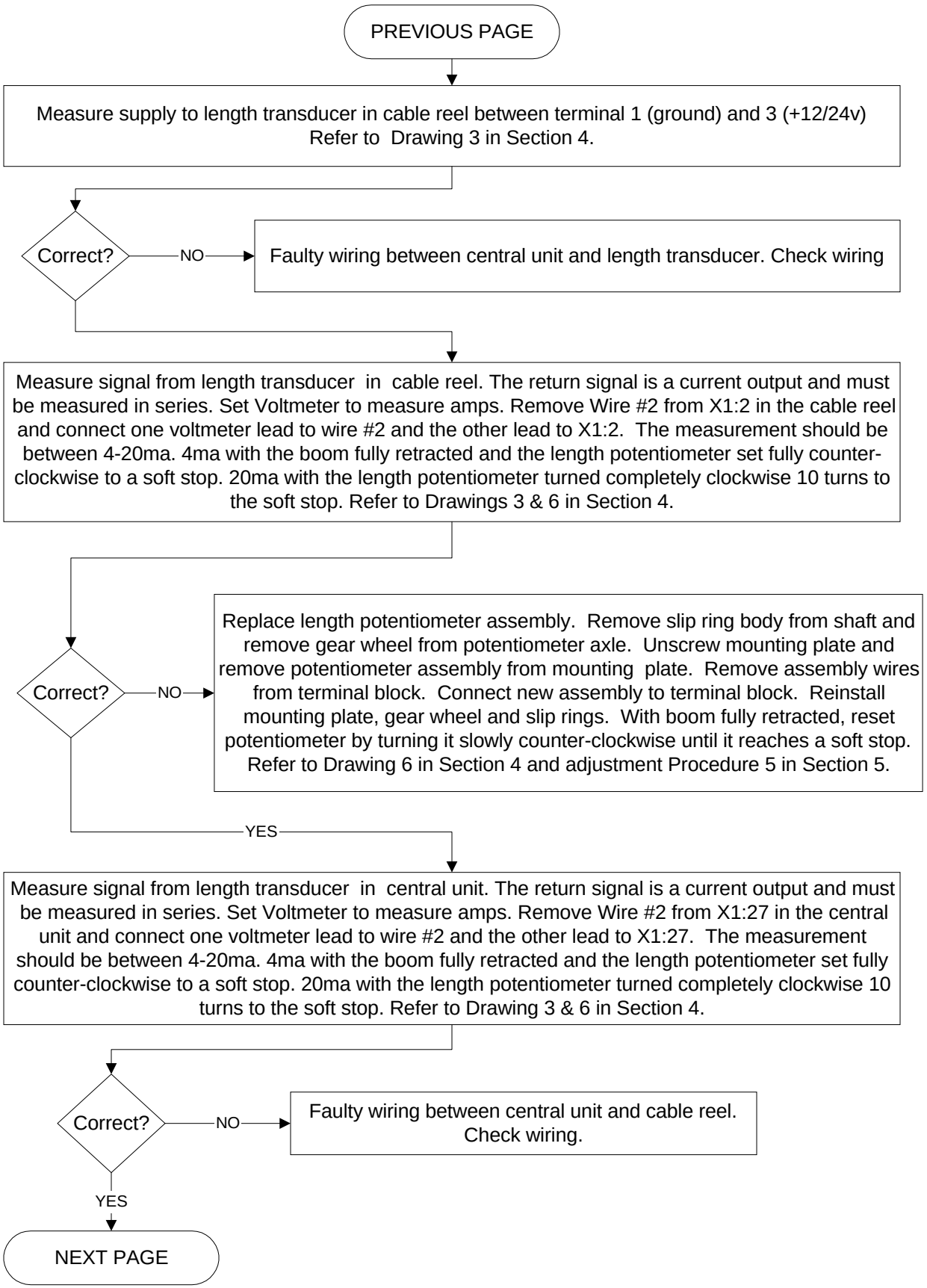

PROBLEM: Function of Anti-Two-Block System is faulty.
START
Check to see whether or not crane is in two-block condition.
Correct?
NO
Lower hook down into safe position
YES
Check Bypass plug installed
Refer to Drawing 3 in Section 4.
Correct?
No
Plug appropriate bypass plug into socket of junction box.
YES
Turn power off or disconnect wire from connection board X1:31 in central unit. Remove the bypass plug and measure the resistance at the boom nose box between terminals 1 and 6 with a ohmmeter. This checks the function of the Anti-Two Block switch.
Switch closed = 0Ohms (weight installed)
Switch open => 1 Megaohm (weight removed)
Pug the bypass plug into the boom nose box.
Refer to Drawing 3 in Section 4.
Correct?
No
Check wire connections in boom nose box. Replace Anti-Two-Block switch.
Refer to Drawing 3 in Section 4.
Yes
Next Page

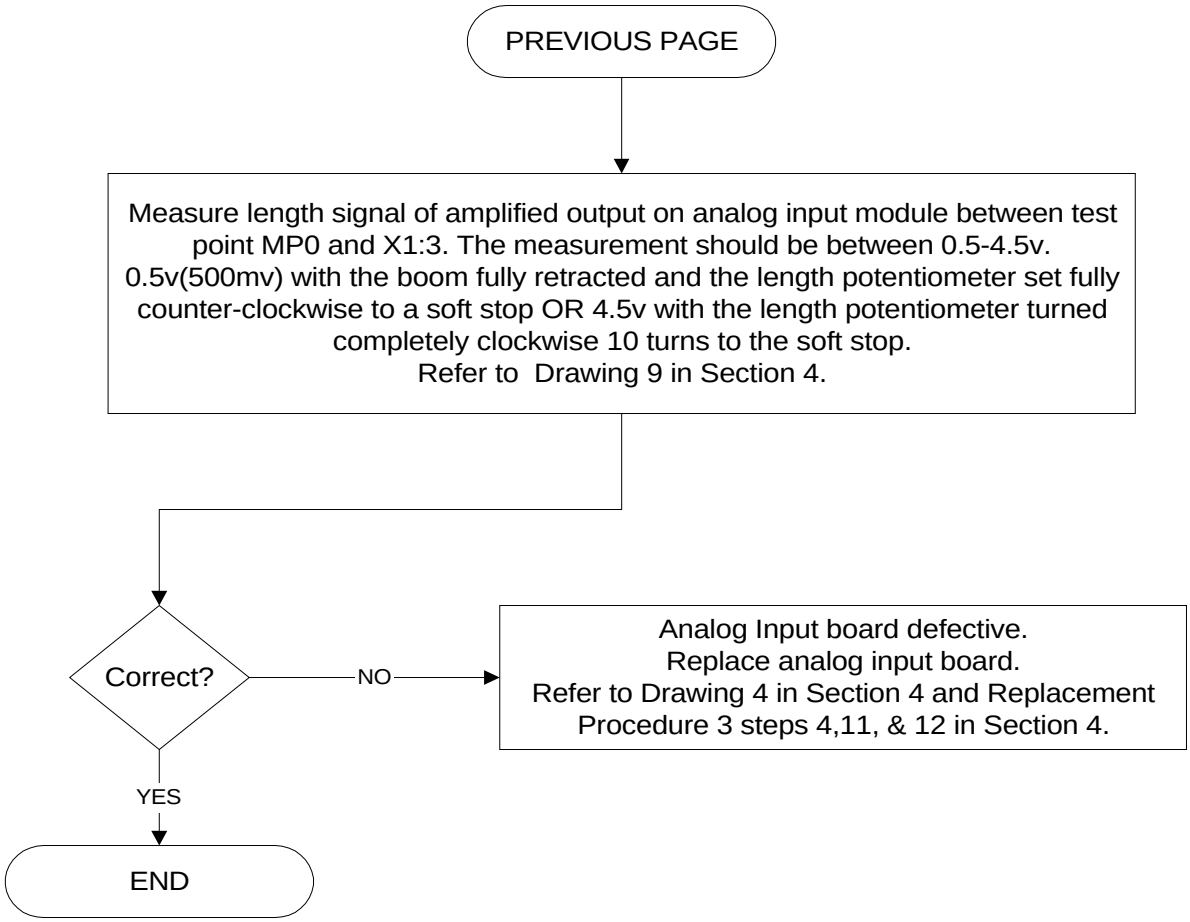

PREVIOUS PAGE
Ensure the byass plug is plugged into the boom nose box. Measure the A2B signal in the cable reel between X1:Brown and X2:Red wires on the slip ring with an ohmmeter.
Switch closed =4700 ±500Ohms
Switch open => 1 Megaohm
Reconnected slip ring wires.
Refer to Drawing 2 & 6 Section 4.
Correct?
No
Fault in wiring between boom nose box and cable reel. Check for damaged length cable and wiring.
Refer to Drawing 3 Section 4.
If broken length cable, Refer to Section 3.4.
Measure the A2B signal in the cable reel between terminal 7 and 8 with an ohmmeter.
Switch closed =4700 ±500Ohms
Switch open => 1 Megaohm
Reconnected slip ring wires.
Refer to Drawing 3 Section 4.
Correct?
No
Replace slip ring
Refer to Drawing 3 & 6 in Section 4.
Measure the A2B signal in the boom base box between terminals 5 and 6 with an ohmmeter.
Switch closed =4700 ±500Ohms
Switch open => 1 Megaohm
Reconnected slip ring wires.
Refer to Drawing 3 Section 4.
Correct?
No
Fault in 7 conductor cable between cable reel and boom base box. Check connections and replace cable if necessary.
Refer to Drawing 3 in Section 4.
NEXT PAGE


PREVIOUS PAGE
Connect wire #5 back to the terminal X1:31 on the connection board.
Refer to Drawing 3 in Section 4.
Turn system power off. Check Anti-Two-Block signal in central unit with ohmmeter measure between X1:31 and X1:32.
Anti-Two-Block switch closed = 4700 Ohms ±50 0Ohms
Anti-Two-Block switch open => 1 Megaohm.
Refer to Drawing 3 in Section 4.
Correct?
NO
Faulty wiring between boom base box and central unit.
Check connections and replace cable if necessary.
YES
Disconnect X1:31 and X1:32. Check main board function by installing a temporary resistor, 4700 Ohms between X1-31 and X1-32 in central unit. With resistor connected alarm should be inactive.
Refer to Drawing 3 in Section 4.
Correct?
NO
Defect on main board. Replace main board.
Refer to Drawing 4 in Section 4 and
Replacement Procedure 3 in Section 5.
Reconnect Wire #5 to X1:31 and Wire #6 to X1:32
Refer to Drawing 3 in Section 4.
End

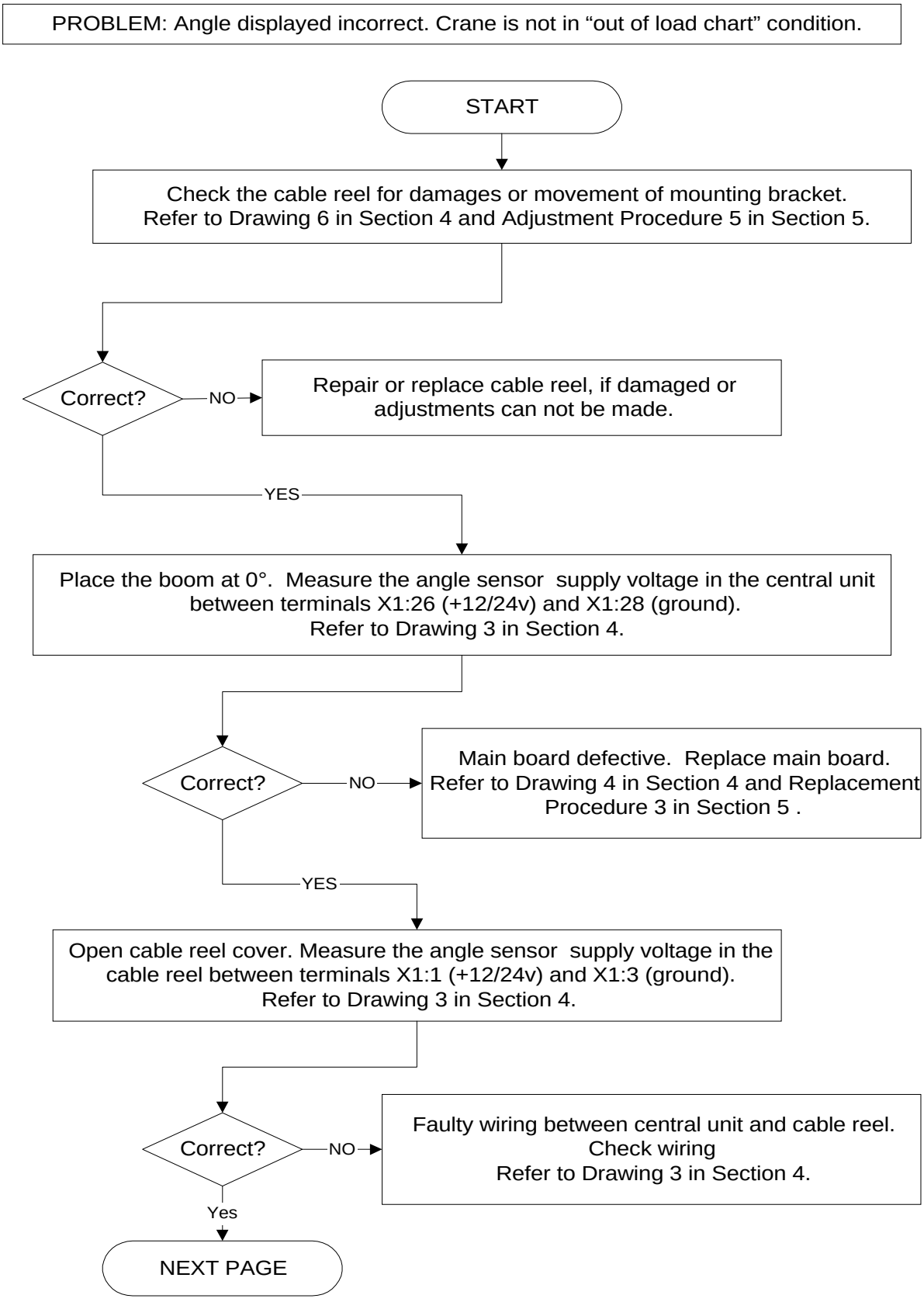
3.7 LENGTH READING PROBLEM

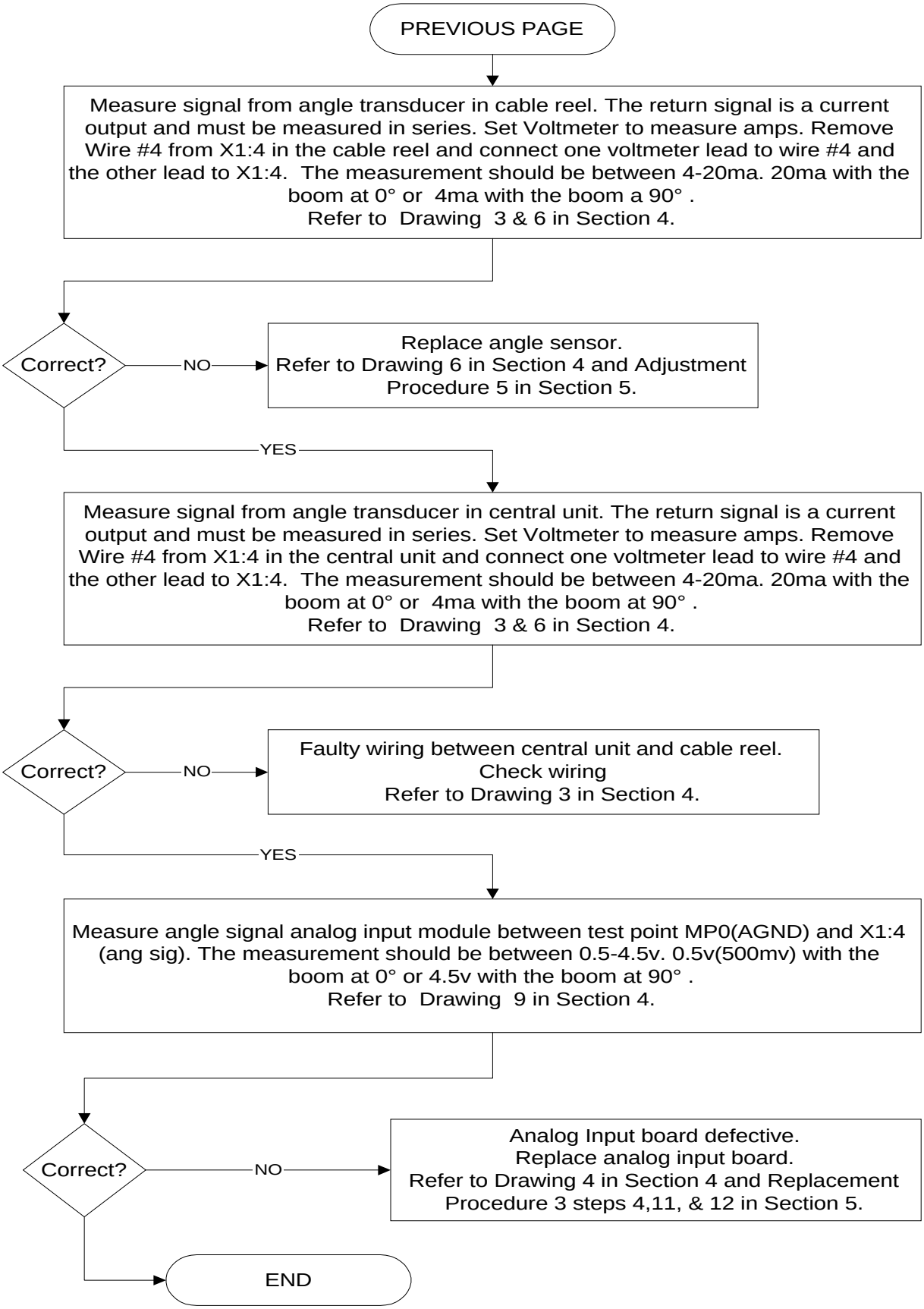

PROBLEM: Length displayed incorrect. Crane is not in “out of load chart” condition.
START
Check mechanical adjustment of length potentiometer in cable reel. With boom fully retracted, reset potentiometer by turning it slowly counter-clockwise until it reaches a soft stop.
Refer to Drawing 6 in Section 4 and Adjustment Procedure 5 in Section 5.
Correct?
NO
Replace length potentiometer assembly, Refer to Drawing 6 in Section 4. Remove slip ring body from shaft and remove gear wheel from potentiometer axle. Unscrew mounting plate and remove potentiometer assembly from mounting plate. Remove assembly wires form terminal block. Connect new assembly to terminal block. Reinstall mounting plate, gear wheel and slip rings. With boom fully retracted, reset potentiometer by turning it slowly counter-clockwise until it reaches a soft stop. Refer to Drawing 3 & 6 in Section 4 and Adjustment Procedure 5 in Section 5.
YES
Check out clutch in big gear wheel of length transducer. Extend and retract boom to ensure that clutch is not slipping on potentiometer axle.
Refer to Drawing 6 in Section 4 and Adjustment Procedure 5 in Section 5.
Correct?
NO
Replace the gear wheel, clean potentiometer axle. Reset length potentiometer.
Refer to Drawing 6 in Section 4 and Adjustment Procedure 5 in Section 5.
YES
Check power supply to length transducer on main board, terminal X1:28 (ground) and X1:26 (+12/24v)
Refer to Drawing 3 in Section 4.
Correct?
NO
Main board defective. Replace main board.
Refer to Drawing 4 in Section 4 and Replacement Procedure 3 in Section 5 .
YES
NEXT PAGE


PREVIOUS PAGE
Measure supply to length transducer in cable reel between terminal 1 (ground) and 3 (+12/24v) Refer to Drawing 3 in Section 4.
Correct?
NO
Faulty wiring between central unit and length transducer. Check wiring
Measure signal from length transducer in cable reel. The return signal is a current output and must be measured in series. Set Voltmeter to measure amps. Remove Wire #2 from X1:2 in the cable reel and connect one voltmeter lead to wire #2 and the other lead to X1:2. The measurement should be between 4-20ma. 4ma with the boom fully retracted and the length potentiometer set fully counter-clockwise to a soft stop. 20ma with the length potentiometer turned completely clockwise 10 turns to the soft stop. Refer to Drawings 3 & 6 in Section 4.
Correct?
NO
Replace length potentiometer assembly. Remove slip ring body from shaft and remove gear wheel from potentiometer axle. Unscrew mounting plate and remove potentiometer assembly from mounting plate. Remove assembly wires from terminal block. Connect new assembly to terminal block. Reinstall mounting plate, gear wheel and slip rings. With boom fully retracted, reset potentiometer by turning it slowly counter-clockwise until it reaches a soft stop. Refer to Drawing 6 in Section 4 and adjustment Procedure 5 in Section 5.
YES
Measure signal from length transducer in central unit. The return signal is a current output and must be measured in series. Set Voltmeter to measure amps. Remove Wire #2 from X1:27 in the central unit and connect one voltmeter lead to wire #2 and the other lead to X1:27. The measurement should be between 4-20ma. 4ma with the boom fully retracted and the length potentiometer set fully counter-clockwise to a soft stop. 20ma with the length potentiometer turned completely clockwise 10 turns to the soft stop. Refer to Drawing 3 & 6 in Section 4.
Correct?
NO
Faulty wiring between central unit and cable reel. Check wiring.
YES
NEXT PAGE

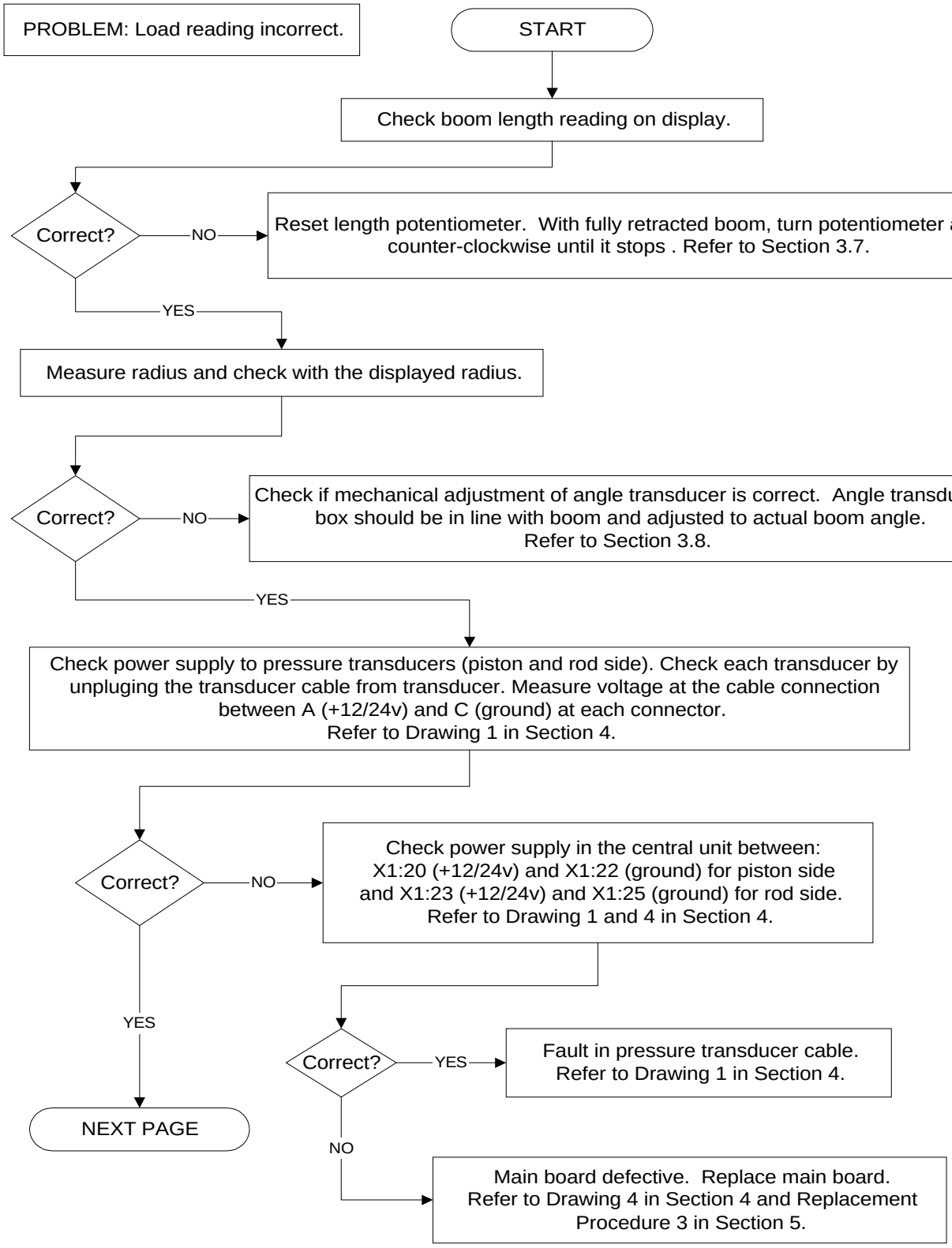

PREVIOUS PAGE
Measure length signal of amplified output on analog input module between test point MP0 and X1:3. The measurement should be between 0.5-4.5v. 0.5v(500mv) with the boom fully retracted and the length potentiometer set fully counter-clockwise to a soft stop OR 4.5v with the length potentiometer turned completely clockwise 10 turns to the soft stop.
Refer to Drawing 9 in Section 4.
Correct?
NO
Analog Input board defective.
Replace analog input board.
Refer to Drawing 4 in Section 4 and Replacement Procedure 3 steps 4,11, & 12 in Section 4.
YES
END

3.8 ANGLE READING PROBLEM

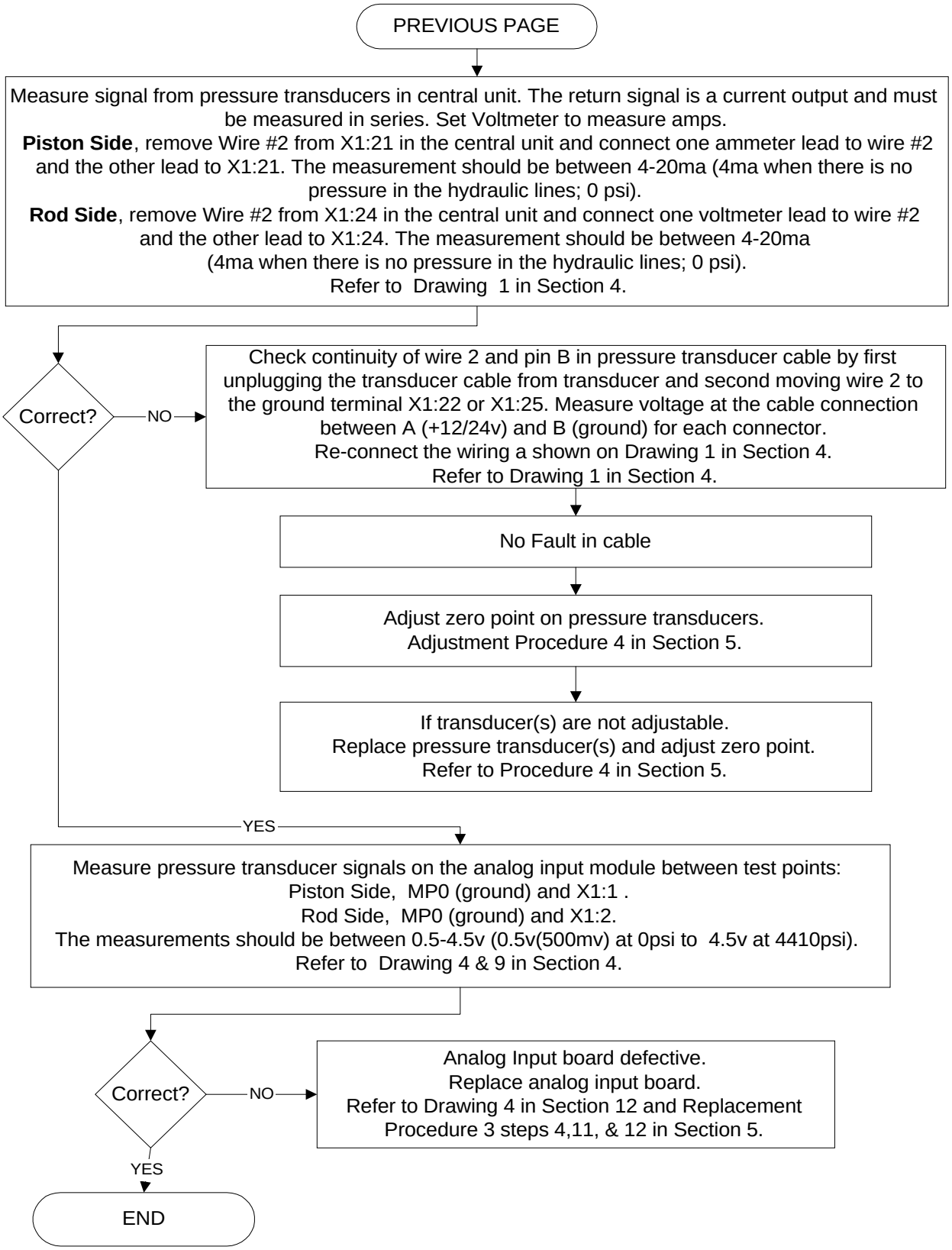

PROBLEM: Angle displayed incorrect. Crane is not in “out of load chart” condition.
START
Check the cable reel for damages or movement of mounting bracket.
Refer to Drawing 6 in Section 4 and Adjustment Procedure 5 in Section 5.
Correct?
NO
Repair or replace cable reel, if damaged or adjustments can not be made.
YES
Place the boom at 0°. Measure the angle sensor supply voltage in the central unit between terminals X1:26 (+12/24v) and X1:28 (ground).
Refer to Drawing 3 in Section 4.
Correct?
NO
Main board defective. Replace main board.
Refer to Drawing 4 in Section 4 and Replacement Procedure 3 in Section 5 .
YES
Open cable reel cover. Measure the angle sensor supply voltage in the cable reel between terminals X1:1 (+12/24v) and X1:3 (ground).
Refer to Drawing 3 in Section 4.
Correct?
NO
Faulty wiring between central unit and cable reel.
Check wiring
Refer to Drawing 3 in Section 4.
Yes
NEXT PAGE

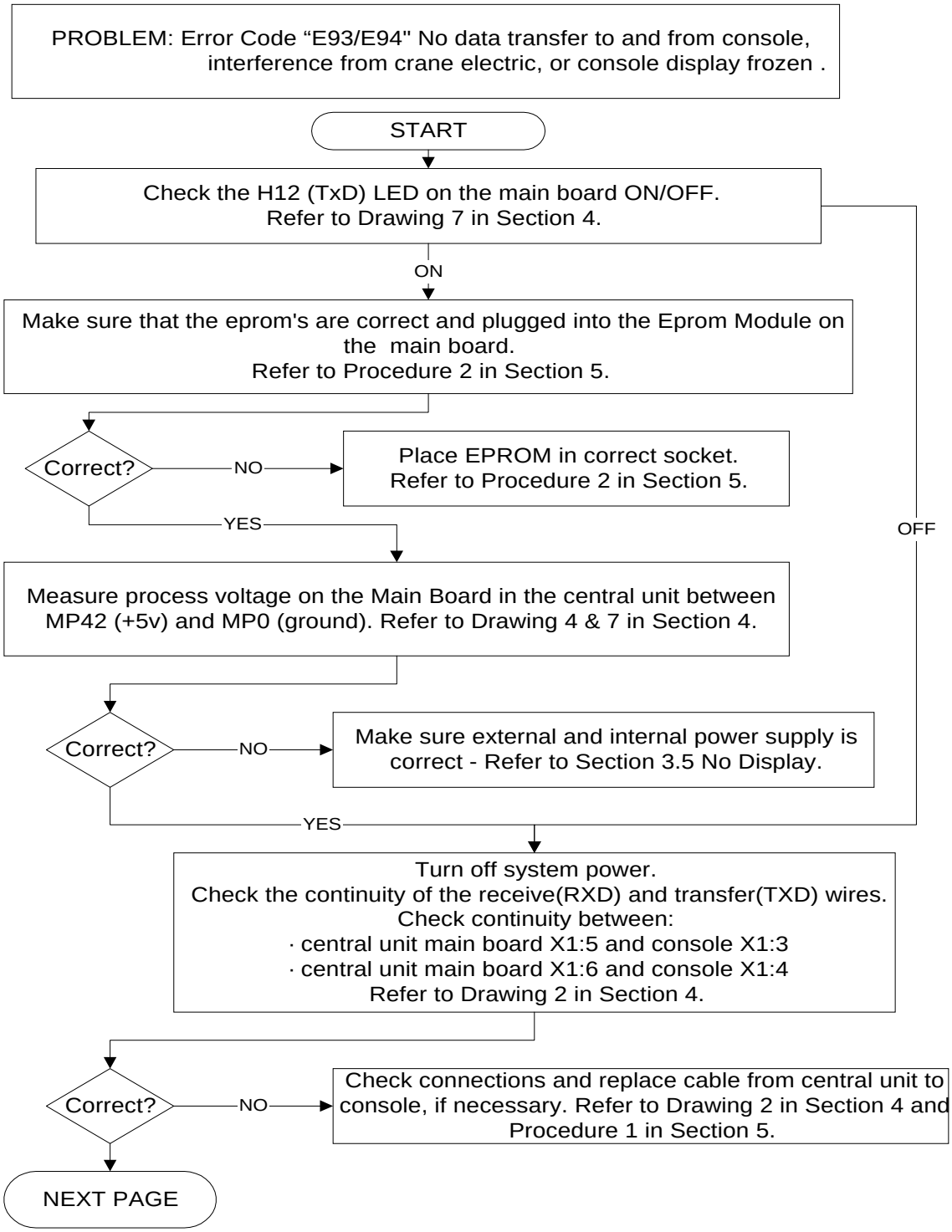

PREVIOUS PAGE
Measure signal from angle transducer in cable reel. The return signal is a current output and must be measured in series. Set Voltmeter to measure amps. Remove Wire #4 from X1:4 in the cable reel and connect one voltmeter lead to wire #4 and the other lead to X1:4. The measurement should be between 4-20ma. 20ma with the boom at 0° or 4ma with the boom a 90° .
Refer to Drawing 3 & 6 in Section 4.
Correct?
NO
Replace angle sensor.
Refer to Drawing 6 in Section 4 and Adjustment Procedure 5 in Section 5.
YES
Measure signal from angle transducer in central unit. The return signal is a current output and must be measured in series. Set Voltmeter to measure amps. Remove Wire #4 from X1:4 in the central unit and connect one voltmeter lead to wire #4 and the other lead to X1:4. The measurement should be between 4-20ma. 20ma with the boom at 0° or 4ma with the boom at 90° .
Refer to Drawing 3 & 6 in Section 4.
Correct?
NO
Faulty wiring between central unit and cable reel.
Check wiring
Refer to Drawing 3 in Section 4.
YES
Measure angle signal analog input module between test point MP0(AGND) and X1:4 (ang sig). The measurement should be between 0.5-4.5v. 0.5v(500mv) with the boom at 0° or 4.5v with the boom at 90° .
Refer to Drawing 9 in Section 4.
Correct?
NO
Analog Input board defective.
Replace analog input board.
Refer to Drawing 4 in Section 4 and Replacement Procedure 3 steps 4,11, & 12 in Section 5.
END

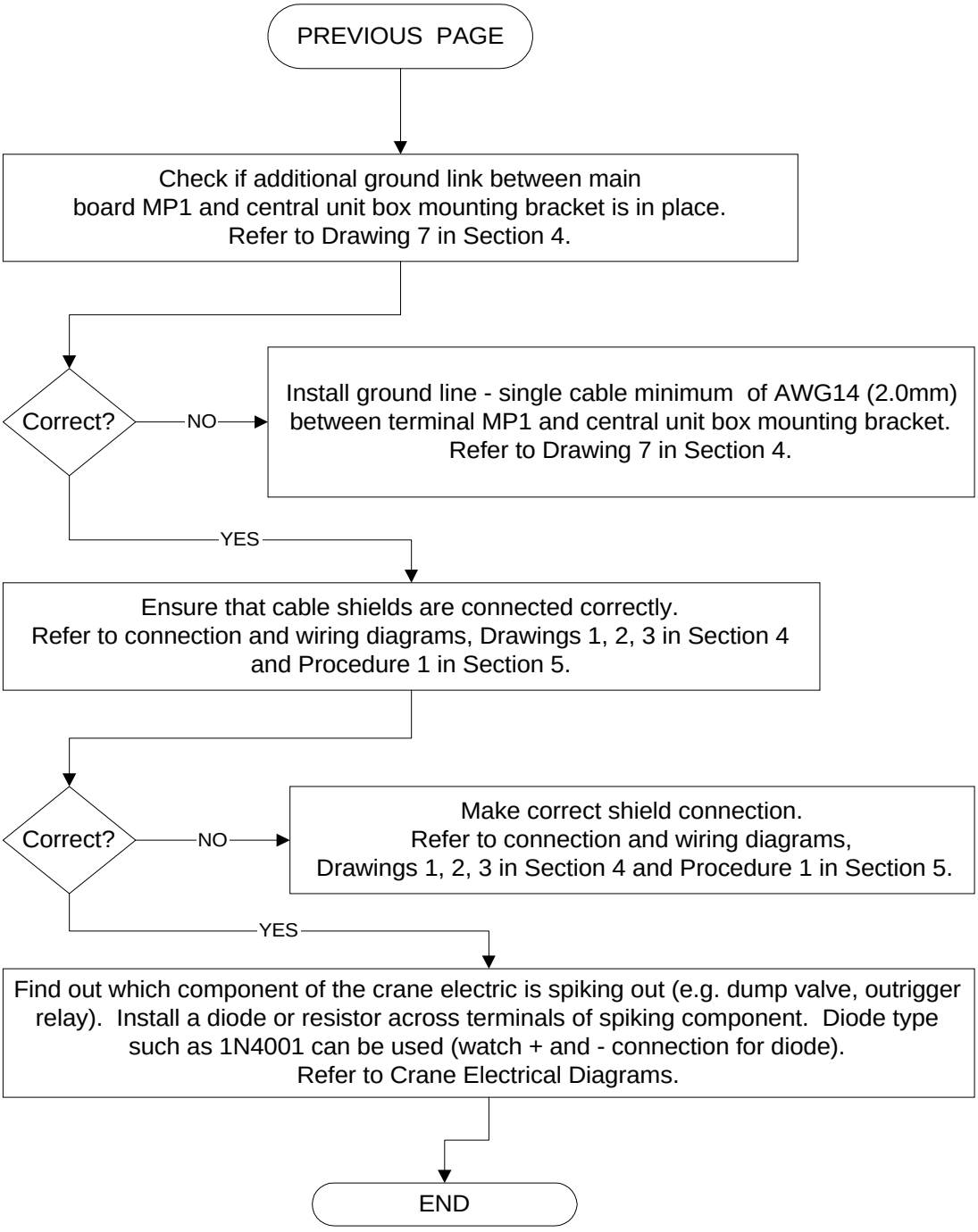
3.9 LOAD READING PROBLEM


PROBLEM: Load reading incorrect.
START
Check boom length reading on display.
Correct?
NO
Reset length potentiometer. With fully retracted boom, turn potentiometer axle counter-clockwise until it stops . Refer to Section 3.7.
YES
Measure radius and check with the displayed radius.
Correct?
NO
Check if mechanical adjustment of angle transducer is correct. Angle transducer box should be in line with boom and adjusted to actual boom angle. Refer to Section 3.8.
YES
Check power supply to pressure transducers (piston and rod side). Check each transducer by unpluging the transducer cable from transducer. Measure voltage at the cable connection between A (+12/24v) and C (ground) at each connector. Refer to Drawing 1 in Section 4.
Correct?
NO
Check power supply in the central unit between: X1:20 (+12/24v) and X1:22 (ground) for piston side and X1:23 (+12/24v) and X1:25 (ground) for rod side. Refer to Drawing 1 and 4 in Section 4.
YES
Correct?
YES
Fault in pressure transducer cable. Refer to Drawing 1 in Section 4.
NEXT PAGE
NO
Main board defective. Replace main board. Refer to Drawing 4 in Section 4 and Replacement Procedure 3 in Section 5.

3.10 BAD DATA TRANSFER BETWEEN CONSOLE & CENTRAL UNIT OR INTERFERENCE PROBLEM


PREVIOUS PAGE
Measure signal from pressure transducers in central unit. The return signal is a current output and must be measured in series. Set Voltmeter to measure amps.
Piston Side, remove Wire #2 from X1:21 in the central unit and connect one ammeter lead to wire #2 and the other lead to X1:21. The measurement should be between 4-20ma (4ma when there is no pressure in the hydraulic lines; 0 psi).
Rod Side, remove Wire #2 from X1:24 in the central unit and connect one voltmeter lead to wire #2 and the other lead to X1:24. The measurement should be between 4-20ma (4ma when there is no pressure in the hydraulic lines; 0 psi).
Refer to Drawing 1 in Section 4.
Correct?
NO
Check continuity of wire 2 and pin B in pressure transducer cable by first unplugging the transducer cable from transducer and second moving wire 2 to the ground terminal X1:22 or X1:25. Measure voltage at the cable connection between A (+12/24v) and B (ground) for each connector.
Re-connect the wiring a shown on Drawing 1 in Section 4.
Refer to Drawing 1 in Section 4.
No Fault in cable
Adjust zero point on pressure transducers.
Adjustment Procedure 4 in Section 5.
If transducer(s) are not adjustable.
Replace pressure transducer(s) and adjust zero point.
Refer to Procedure 4 in Section 5.
YES
Measure pressure transducer signals on the analog input module between test points:
Piston Side, MP0 (ground) and X1:1 .
Rod Side, MP0 (ground) and X1:2.
The measurements should be between 0.5-4.5v (0.5v(500mv) at 0psi to 4.5v at 4410psi).
Refer to Drawing 4 & 9 in Section 4.
Correct?
NO
Analog Input board defective.
Replace analog input board.
Refer to Drawing 4 in Section 12 and Replacement Procedure 3 steps 4,11, & 12 in Section 5.
YES
END

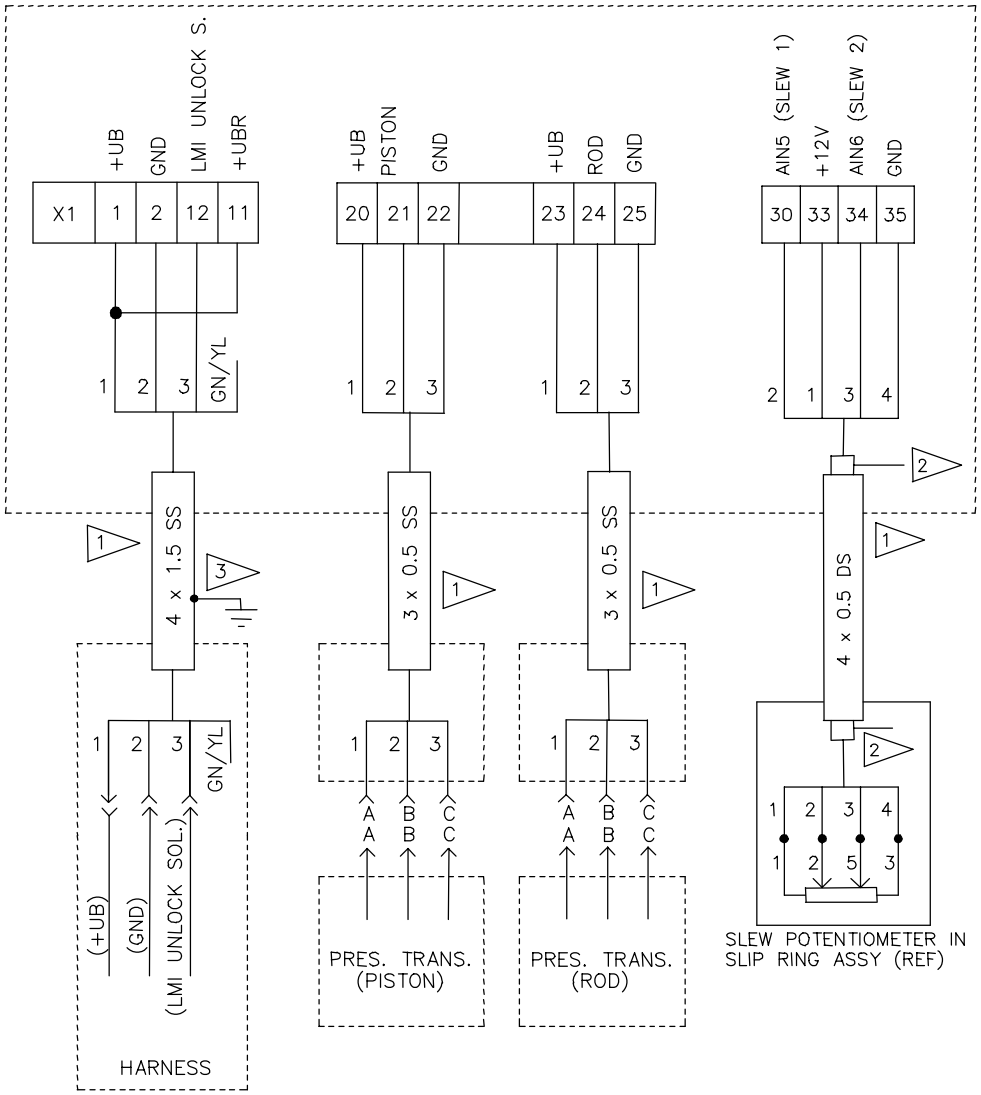

PROBLEM: Error Code “E93/E94" No data transfer to and from console, interference from crane electric, or console display frozen .
START
Check the H12 (TxD) LED on the main board ON/OFF.
Refer to Drawing 7 in Section 4.
ON
OFF
Make sure that the eprom's are correct and plugged into the Eprom Module on the main board.
Refer to Procedure 2 in Section 5.
Correct?
NO
Place EPROM in correct socket.
Refer to Procedure 2 in Section 5.
YES
Measure process voltage on the Main Board in the central unit between MP42 (+5v) and MP0 (ground). Refer to Drawing 4 & 7 in Section 4.
Correct?
NO
Make sure external and internal power supply is correct - Refer to Section 3.5 No Display.
YES
Turn off system power.
Check the continuity of the receive(RXD) and transfer(TXD) wires.
Check continuity between:
· central unit main board X1:5 and console X1:3
· central unit main board X1:6 and console X1:4
Refer to Drawing 2 in Section 4.
Correct?
NO
Check connections and replace cable from central unit to console, if necessary. Refer to Drawing 2 in Section 4 and Procedure 1 in Section 5.
NEXT PAGE


PREVIOUS PAGE
Check if additional ground link between main board MP1 and central unit box mounting bracket is in place. Refer to Drawing 7 in Section 4.
Correct?
NO
Install ground line - single cable minimum of AWG14 (2.0mm) between terminal MP1 and central unit box mounting bracket. Refer to Drawing 7 in Section 4.
YES
Ensure that cable shields are connected correctly. Refer to connection and wiring diagrams, Drawings 1, 2, 3 in Section 4 and Procedure 1 in Section 5.
Correct?
NO
Make correct shield connection. Refer to connection and wiring diagrams, Drawings 1, 2, 3 in Section 4 and Procedure 1 in Section 5.
YES
Find out which component of the crane electric is spiking out (e.g. dump valve, outrigger relay). Install a diode or resistor across terminals of spiking component. Diode type such as 1N4001 can be used (watch + and - connection for diode). Refer to Crane Electrical Diagrams.
END

4 DRAWINGS

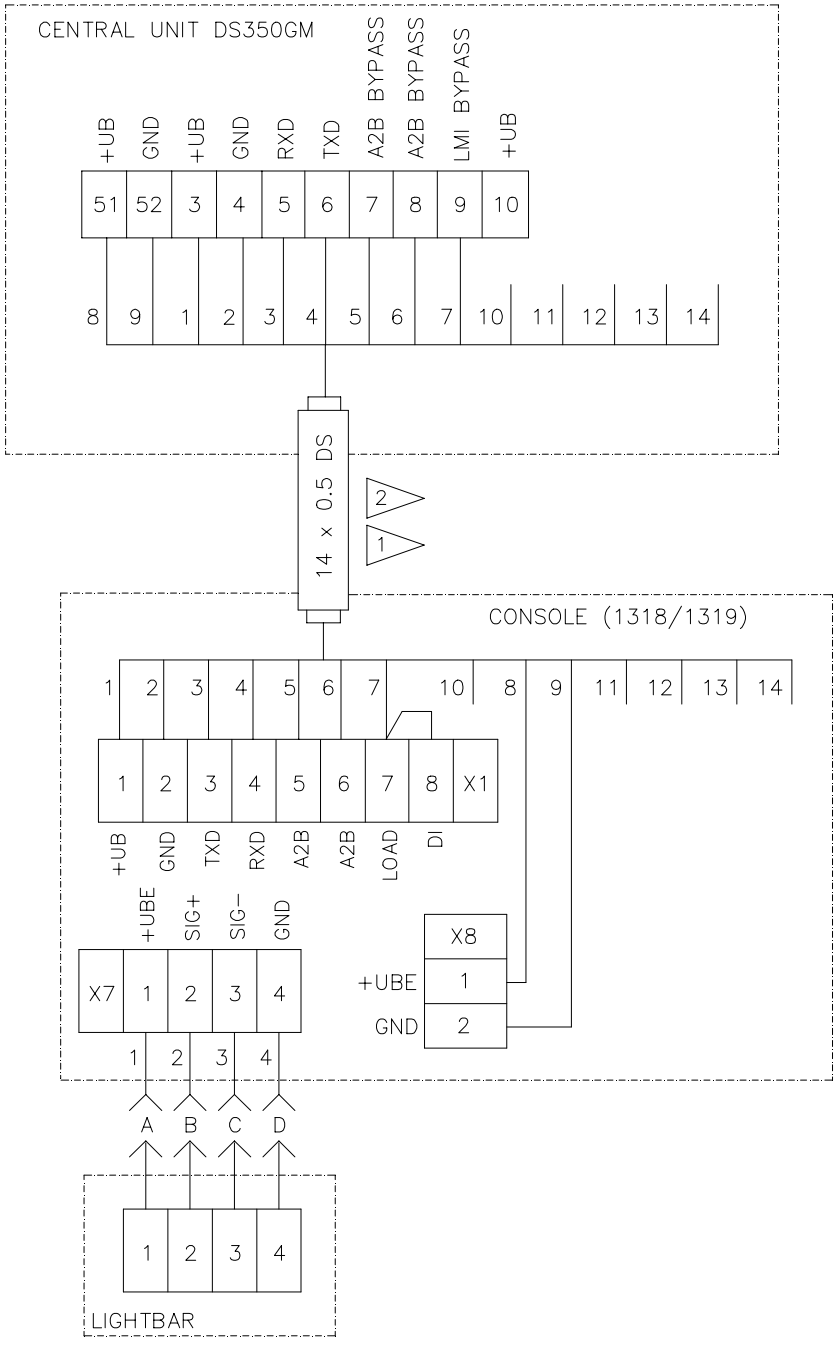
4.1 DRAWING 1. ELECTRICAL WIRING FOR CENTRAL UNIT TO PRESSURE TRANSDUCERS AND CRANE

CENTRAL UNIT DS350GM
MAIN BOARD: PAT 024-352-300-001



4.2 DRAWING 2. ELECTRICAL WIRING FOR CENTRAL UNIT TO CONSOLE

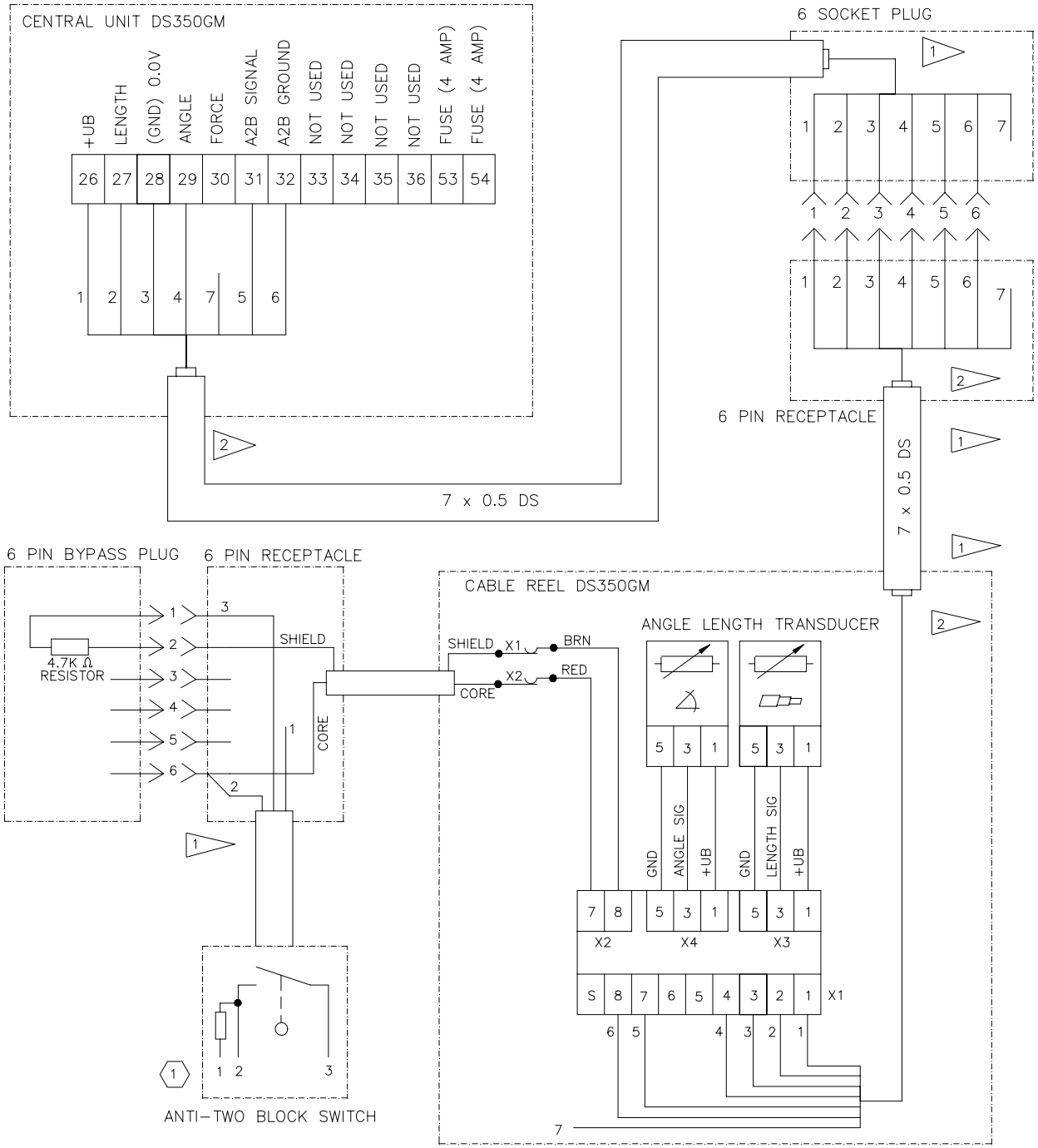
CENTRAL UNIT DS350GM
MAIN BOARD: PAT 024-352-300-001



See reference notes on Drawing 1.

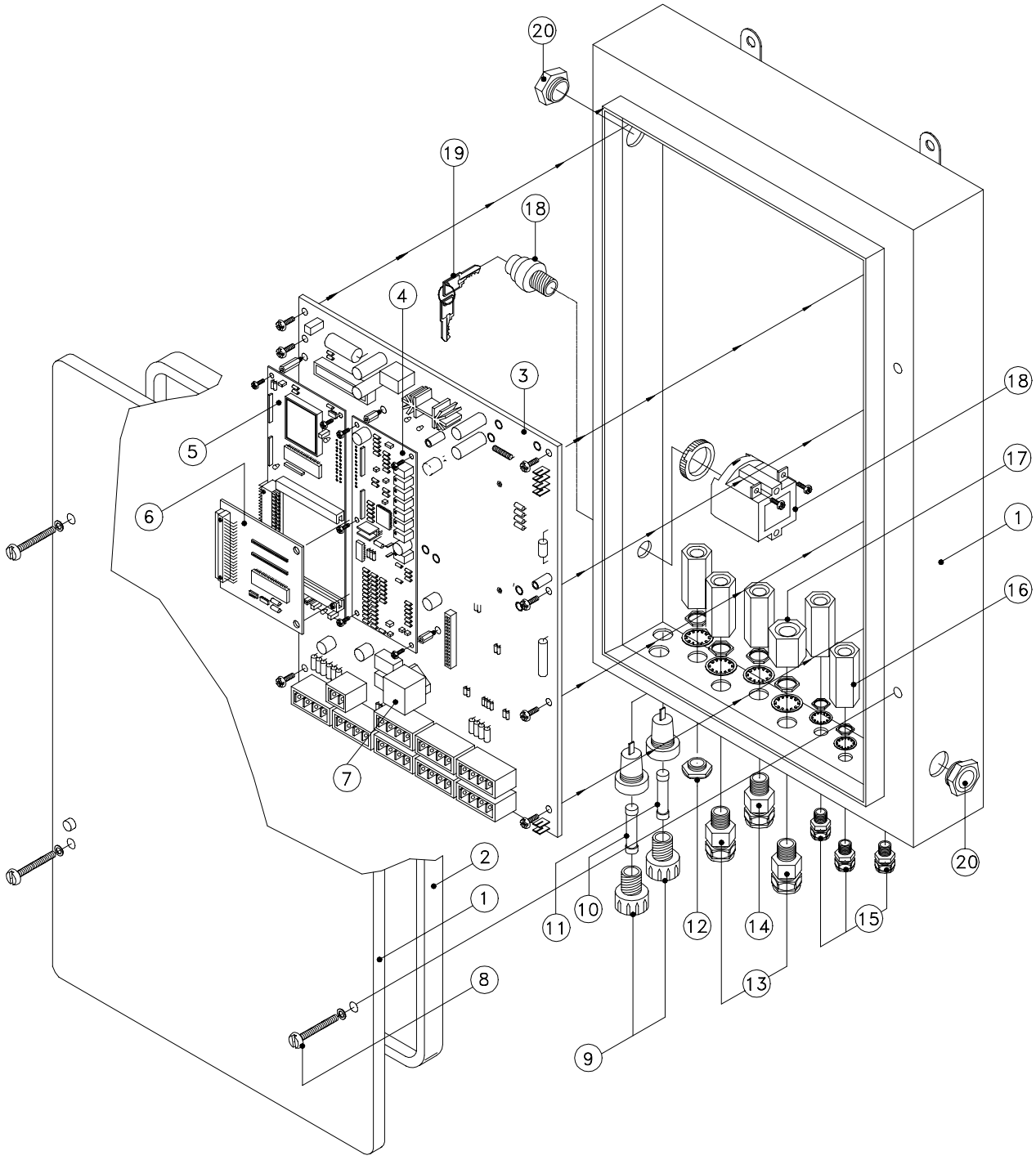
4.3 DRAWING 3. ELECTRICAL WIRING FOR CENTRAL UNIT TO CABLE REEL/ANTI-TWO BLOCK

CENTRAL UNIT DS350GM



MAIN BOARD: PAT 024-352-300-001

4.4 DRAWING 4. CENTRAL UNIT - PARTS LIST

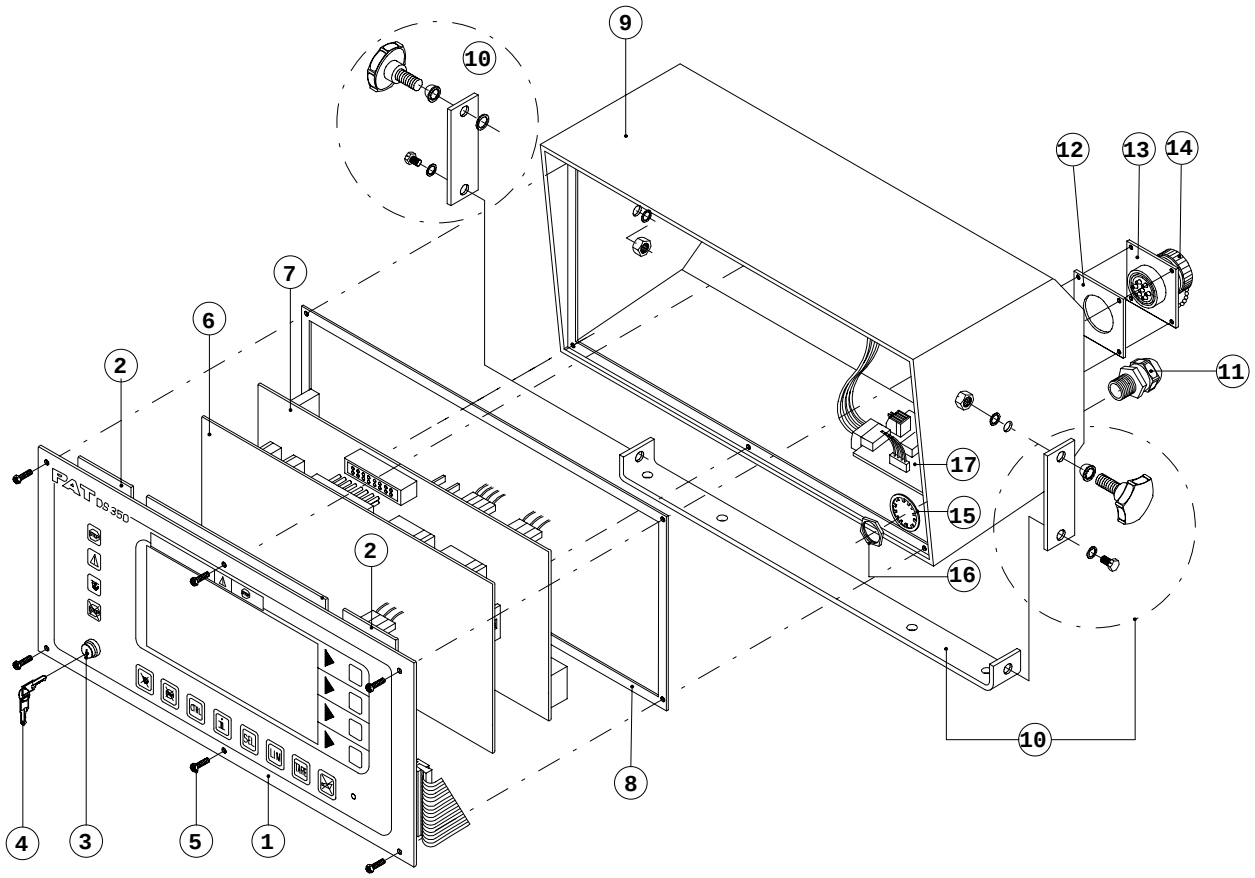


DRAWING 4. CENTRAL UNIT - PARTS LIST - continued

PART NO. A) PAT 024-350-063-001
PART NO. B) PAT 024-350-063-002

NO.	PART NO.	QTY	DESCRIPTION
01	024-350-050-292	1	HOUSING W/COVER, CENTRAL UNIT
02	024-350-110-067	1	GASKET
03	024-352-300-001	1	MAIN, BOARD
04	024-352-300-020	1	ANALOG INPUT MODULE
05	024-351-300-007	1	CPU MODULE
06	024-351-300-011	1	EPROM MODULE
07A	000-304-140-112	1	RELAY 12V
07B	000-304-140-241	1	RELAY 24V
08	024-350-100-135	1	SCREW SET
09	000-314-022-006	2	FUSE HOLDER
10	000-313-062-002	1	FUSE 10amp 250V FAST ACTING
11	000-313-064-001	1	FUSE 4amp 250V FAST ACTING
12	000-214-340-013	1	HOLE PLUG, PG13.5
13	021-441-131-013	2	STRAIN RELIEF, PG13.5 RED/WHT
14	021-441-161-213	1	STRAIN RELIEF, PG13.5 W/ GREY/WHT
15	021-441-090-709	3	STRAIN RELIEF, PG9 W/ BLACK/WHITE
16	024-000-100-260	5	FERRITE FILTER PG13.5
17	024-000-100-261	1	FERRITE FILTER PG16
18	024-350-100-661	1	KEYSWITCH
19	031-300-101-131	1	SPARE KEY
20	024-000-100-095	2	MEMBRANE ELEMENT, BREATHER

DRAWING 5B. CONSOLE DS350/1318 - PARTS LIST

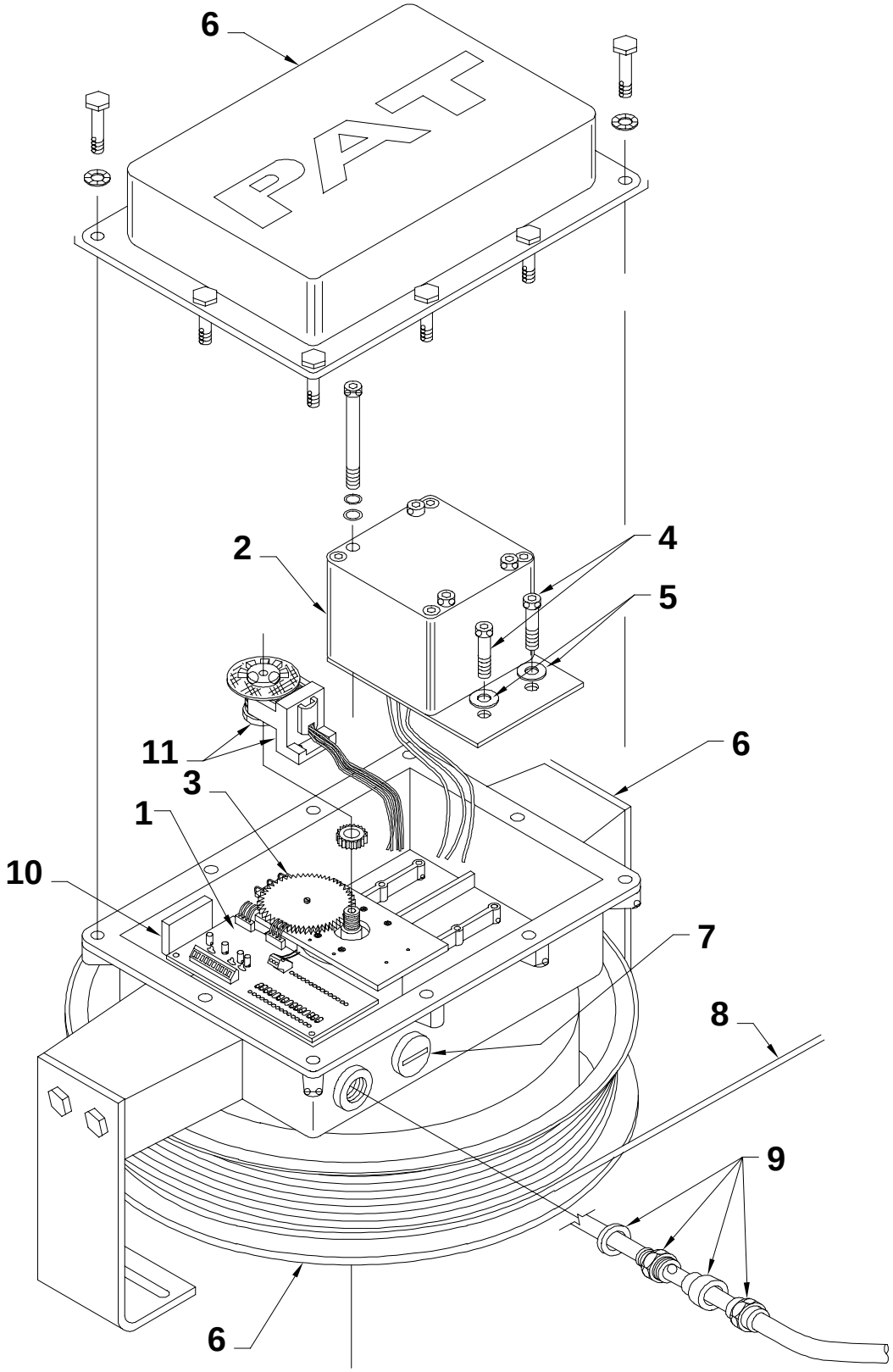


DRAWING 5B. CONSOLE DS350/1318 - PARTS LIST - continued

GRAPHIC CONSOLE (HORIZONTAL), PARTS LIST
PART NO. PAT 050-350-061-318

NO.	PART NO.	QTY	DESCRIPTION
01	031-300-110-049	1	CONSOLE ACCY, FRONT FACE & DIS.
02	050-150-300-052	1	BOARD, PUSHBUTTON SET(KEYBRDS)
03	003-051-905-235	1	SWITCH, KEY
04	050-350-110-139	1	KEY, SPARE
05	002-053-703-101	6	SCREWS, FRONT PANEL MOUNTING
06	050-150-300-050	1	BOARD
07	050-150-300-051	1	TERMINAL BOARD
08	050-000-050-625	1	SEALING, FRONT PANEL
09	050-000-100-180	1	HOUSING
10	050-350-110-263	1	MOUNTING KIT FOR HOUSING
11	021-448-161-213	1	STRAIN RELIEF, PG13.5 GREY/WHT
12	031-300-100-173	1	GASKET
13	031-300-100-392	1	CANNON CONN., 7-SOCKET RECPT.
14	031-300-100-024	1	DUST CAP
15	000-208-010-210	1	TOOTHWASHER, M12
16	000-214-210-013	1	LOCKNUT, PG13.5
17	050-350-300-076	1	BOARD, TERMINAL INTERFACE FOR LIGHTBAR

4.5 DRAWING 6. CABLE REEL - PARTS LIST

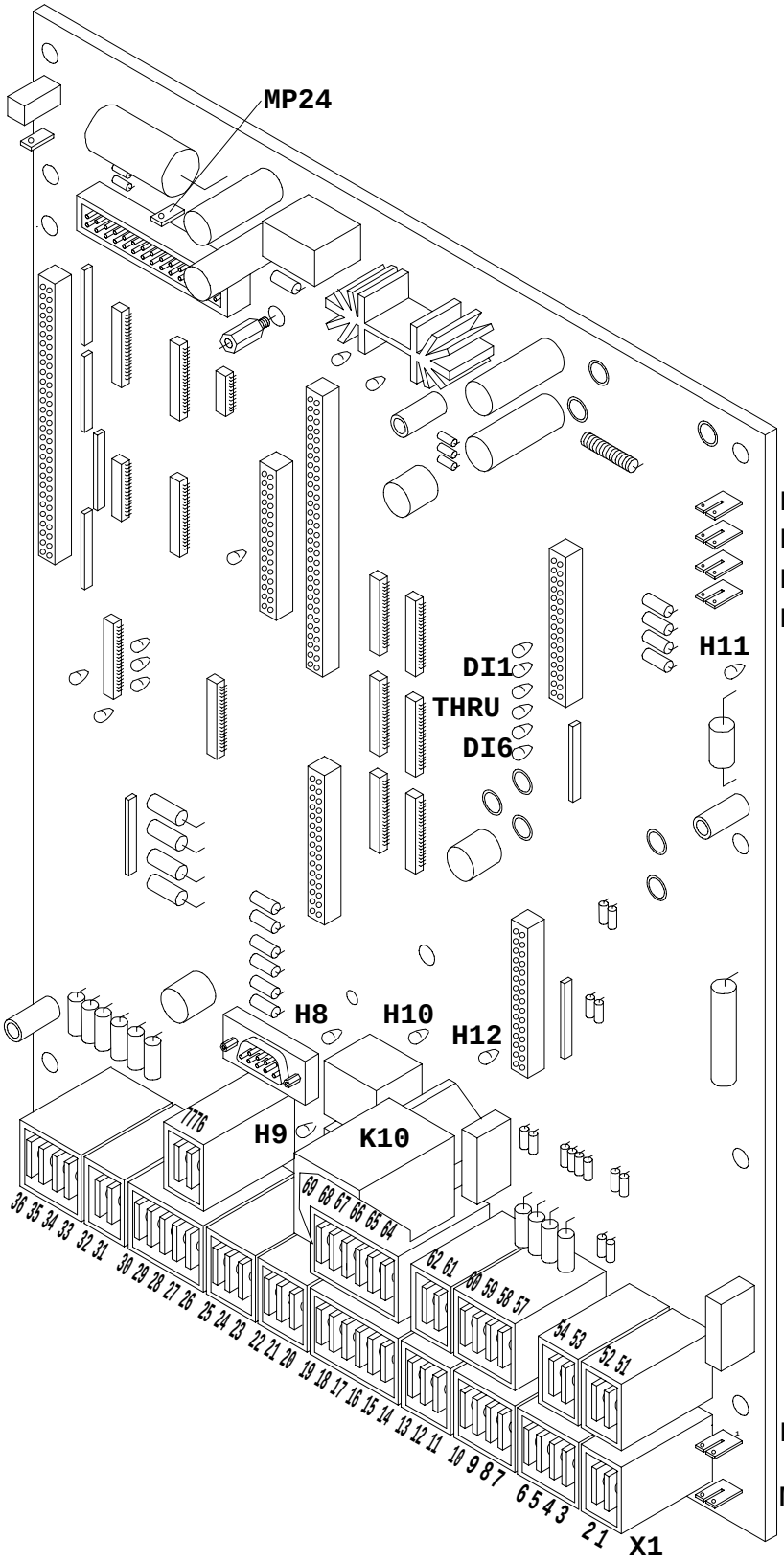


DRAWING 6. CABLE REEL - PARTS LIST - continued

CABLE REEL ASSEMBLY, PARTS LIST
PART NO. PAT 068-308-060-001

NO.	PART NO	QTY	DESCRIPTION
01	068-000-300-060	1	BOARD, TERMINAL W/ EMC FILTERS
02	064-103-060-007	1	ANGLE SENSOR WG103/0007
03	068-000-300-018	1	LENGTH POTENTIOMETER UNIT
04	002-050-206-012	2	SCREW M6 X 12 HEX SOCKET CAP
05	000-207-010-064	2	WASHER M6 FLAT
06	068-000-100-152	1	HOUSING KT200
07	000-214-340-013	1	PG13.5 HOLE PLUG
08	000-673-020-002	139’	CABLE, LENGTH SINGLE CORE
09	002-148-131-013	1	STRAIN RELIEF, PG13.5 RED/WHT
10	031-300-100-206	1	CHEMICAL, CORROSION INHIBITOR
11	068-000-100-064	1	SLIP RING ASSEMBLY 2 POLE

4.6 DRAWING 7. CENTRAL UNIT MAIN BOARD LAYOUT

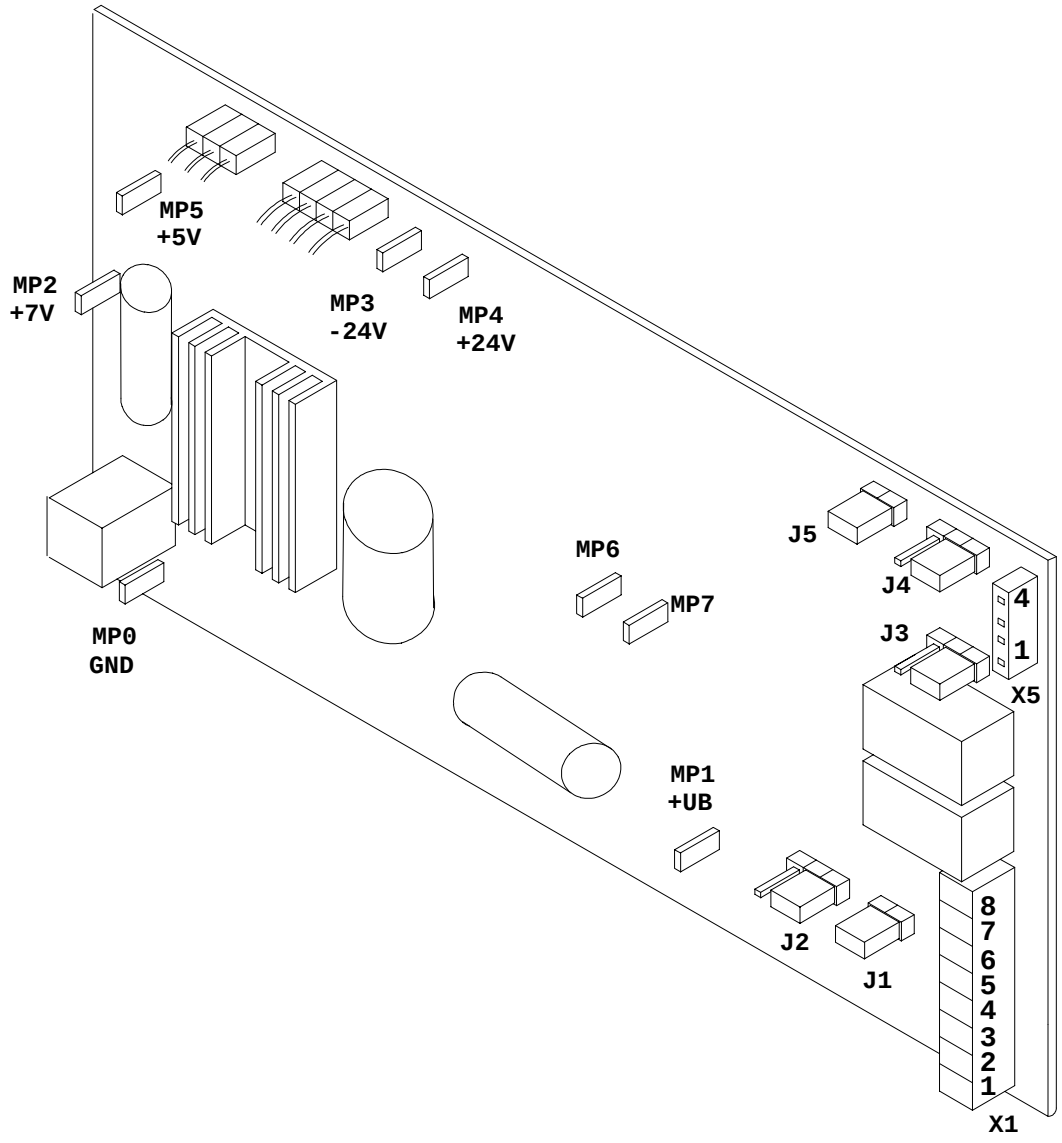


BOARD P/N
024-352-300-001

MP1 = KGND
MP4 = + 5V
MP8 = + 9V
MP9 = + 6V
MP24 - = + BATT
MP25 - = + UBS console, sensors, DI's
MP26 - = GND
MP29 - = + 5V hand terminal

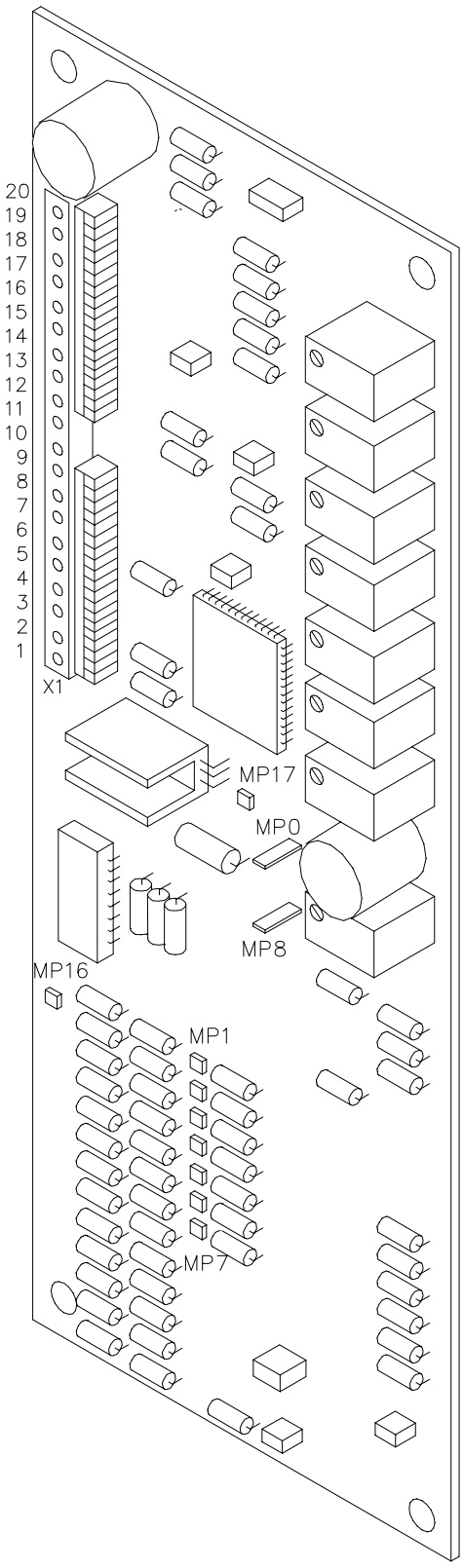
LED'S
H08 - LOAD
H09 - A2B
H10 - MAIN IN/OUT
H11 - POWER
H12 - TxD

4.7 DRAWING 8. CONSOLE CONNECTION BOARD



BOARD PART NUMBER 050 150 30 0051

4.8 DRAWING 9. CENTRAL UNIT ANALOG INPUT MODULE



BOARD P/N 024-352-300-020

X1:1-7 = ADC INPUT 0.5V...4.5V, Note: If channel adjustments are made through the software and graphic console, DO NOT adjust offset with P1-P7.
X1:8 = TEMP (0.5V + 10mV/°C)
X1:9 = VREFA = 5.000V reference
X1:10 = AGND (reference GND)
X1:11 = VREF+ = 5.0V power ADC
X1:12-15 = CH01-04, DIN1-4 / 10
X1:16 = CH05, +UBS / 10
X1:17 = CH06, HESIN(A2B) * 4
X1:18 = CH07, +9V * 4
X1:19 = CH08, VREFA / 2 = 2.500V
X1:20 = UKLEMM, app. VREFA, limits ADC input to 5.0V

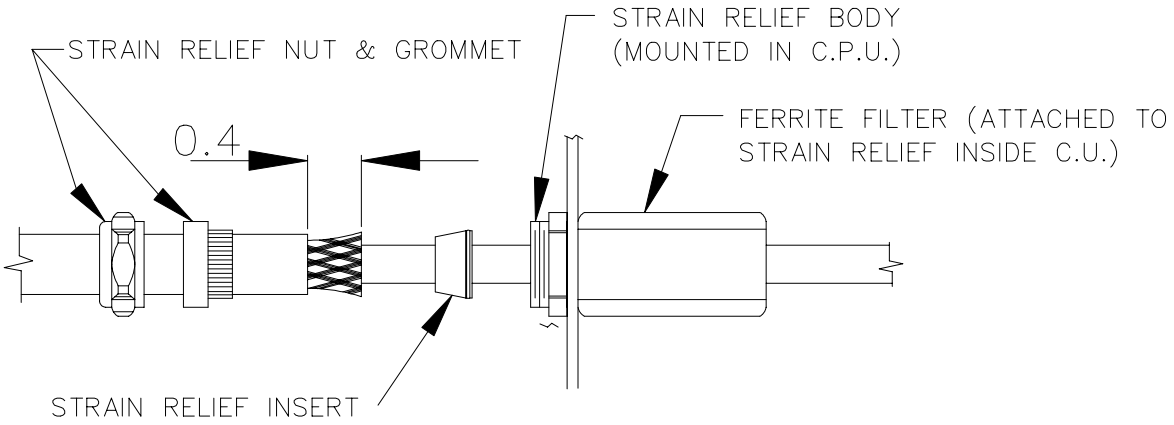
MP1 = AGND
MP8 = +5V
MP1-7 = Input channels 1-7 0.5V/4mA...2.5V/20mA
MP14 = +13V REF02
MP16 -= HESIN input voltage
MP17 = app 5.4V clamp for inputs

The analog input module converts the sensor signals on channels 1-7 to signals that will be process at the CPU and software. The incoming signal measured at the measuring points (MP) will be 0.5V/4mA...2.5V/20mA. The analog input module then converts the channel signals to 0.5V...4.5V, which can be measured on X1:1 through X1:7.
The signal voltage can be measured at either point using ground and the signal input.

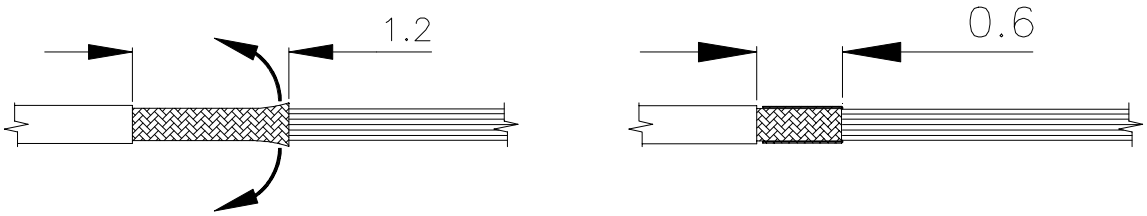
5 PROCEDURES

5.1 PROCEDURE 1. STRAIN RELIEF INSTALLATION

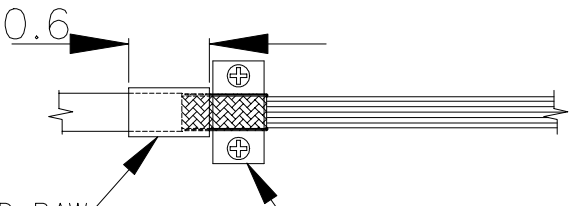
OUTTER SHIELD GROUNDED AT STRAIN RELIEF WITH FERRITE FILTER



INNER SHIELD GROUNDED ON CONNECTION BOARD



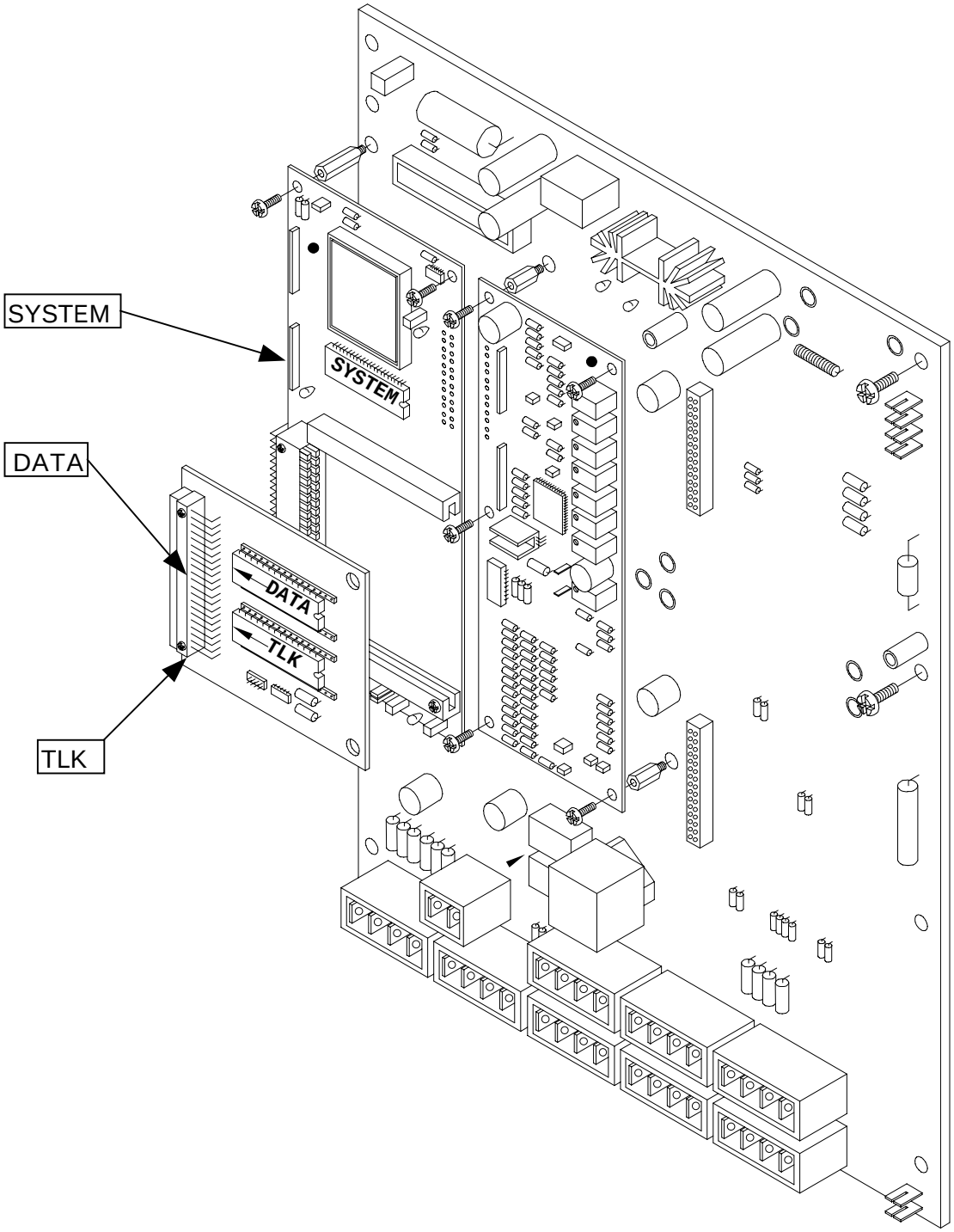
CUT INNER SHIELD BACK TO APPROXIMATELY 1.2 INCH.
THEN FOLD INNER SHIELD BACK TO INNER JACKET,
SO THE INNER SHEILD IS 0.6 INCHES IN LENGTH.



COVER INNER JACKET AND RAW
EDGE OF INNER SHIELD WITH
HEAT SHRINK TUBING

SECURE INNER SHIELD TO GROUND
CLAMP ON CONNECTION BOARD IN C.U.
REFER TO DRAWING 3, CENTRAL UNIT

5.2 PROCEDURE 2. EPROM LOCATION AND INSTALLATION



- Ensure the notch is in the correct direction.
- The DATA and TLK EPROMs fill the bottom of the socket as shown by the arrows.
- Place EPROMs in the correct EPROM socket as shown.

5.3 PROCEDURE 3. MAIN BOARD REPLACEMENT

Refer to Drawing 4, central unit parts list for board location.

1. Turn system power off.
2. Remove the central unit lid.

NOTE: Take care not to damage the boards with the screwdriver, when removing and inserting screws.

NOTE: Use care when lifting the CPU module board and analog input module from the main board because these boards have pins on the bottom side which insert into the main board.

3. Remove CPU module board by taking out the 4 small Philips screws holding it in place.
4. Remove analog input module board by taking out the 6 small Philips screws holding it in place.
5. Remove the relay from the main board, item 7 on Drawing 4 in Section 4.4.
6. Mark all connection wires before removing, to identify location for reconnecting. Disconnect all X1 terminal wires from the main board.
7. Remove the 14 large Philips screws holding the main board in place.
8. Take notice of the orientation of the main board in the central unit. Remove main board and place in the packing material that the replacement main board came in.
9. Carefully insert the new main board in place. Refer to Drawing 4 in Section 4.4 for location.
10. Insert the 14 Philips mounting screws, be sure to attach the ground wire to the KGND screw in the lower left corner. Refer to Drawing 4.
11. Insert analog input module board by lining up the pins into the sockets X16 and X17 and the 6 screw holes.
12. Insert the 6 small Philips screws and washers.
13. Insert CPU module board by lining up the pins into the sockets X11 and X12 and the 4 screw holes.
14. Insert the 4 small Philips screws and washers.
15. Insert the relay on to the main board, item 7 on Drawing 4.
16. Connect the X1 terminal wires to the main board. Refer to Drawings 1, 2 and 3.
17. Inspect the gasket for nicks, cuts, or damages. Refer to 031-300-340-003 DS 350 Central Unit Gasket Recommendations, Revision - and 031-300-340-002 Central Unit Cover Installation and Tightening Procedure, Revision A.

5.4 PROCEDURE 4. PRESSURE TRANSDUCER ZERO ADJUSTMENT

5.4.1 USING GRAPHIC CONSOLE FOR ZERO-SETTING OF PRESSURE TRANSDUCER & FORCE INPUTS

The zero setting consists of defining zero-point offset. The zero point offset is added to the transducer measurement to calculate the real physical pressure or force.
To define the zero-point offset the pressure transducer or force sensor must be in equilibrium (no load condition). Therefore the boom must be lowered all the way down (no rest pressure) and the hydraulic hoses disconnected from the pressure transducers.
CAUTION: Ensure there is no pressure in the hydraulic line when disconnecting the hoses from pressure transducers.

5.4.1.A ACTIVATING THE ZERO-SETTING FUNCTION

To activate the zero-setting Function, press the INFO key on the console to activate the INFO Function. Now press the CTRL key. At this point, a five digit Authorization Number must be entered. Only authorized personnel may adjust the zero-point settings.
Example: 6 4 3 5 6

5.4.1.B ZERO-SETTING THE TRANSDUCER INPUTS

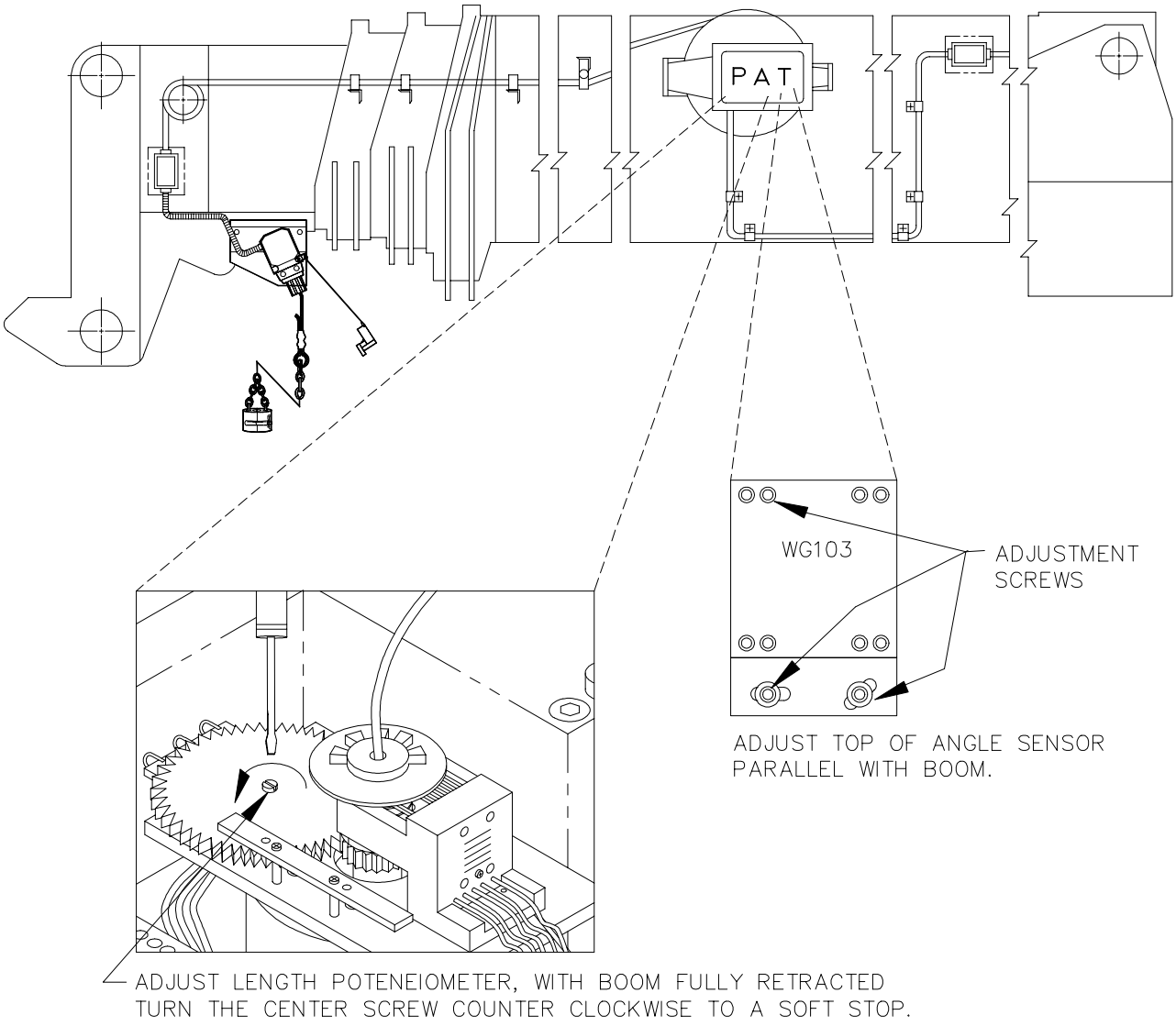
Now, having successfully entered a valid password, the piston-side zero-point setting function is activated.

The display shows which transducer (piston-side, rod-side or force) is being zeroed and a horizontal dial marks the present pressure (or force) difference in %. By pressing the + key, the input pressure (or force) is adjusted upwards, and by pressing the minus (-)key, the input value is adjusted downwards. When the plus (+) and minus (-) keys are pressed simultaneously, the zero setting occurs automatically. Manual adjustments may be preformed using + or -.

The return key toggles between the piston-side, the rod-side, and the force zero-setting.

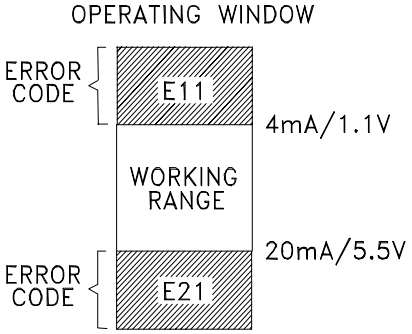
When the operator is finished, pressing the EXC or INFO key returns the console display to normal.

5.5 PROCEDURE 5. LENGTH AND ANGLE SENSOR ADJUSTMENT


PAT
WG103
ADJUSTMENT SCREWS
ADJUST TOP OF ANGLE SENSOR PARALLEL WITH BOOM.
ADJUST LENGTH POTENEIOMETER, WITH BOOM FULLY RETRACTED
TURN THE CENTER SCREW COUNTER CLOCKWISE TO A SOFT STOP.

6 THEORY

6.1 THEORY 1. OPERATION OF BOOM LENGTH SENSOR



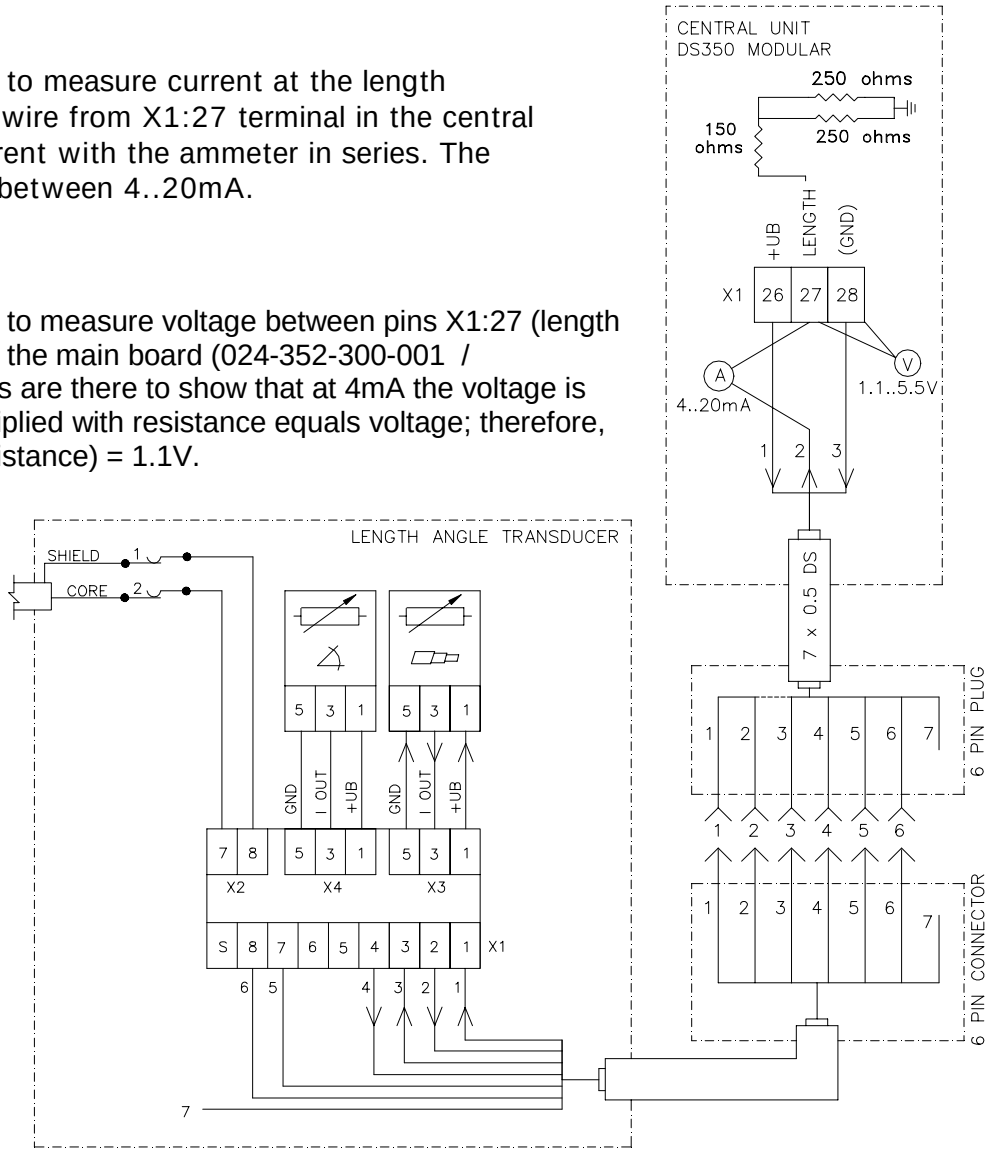
The system sensors provide a 4 to 20mA output; however, due to a fixed resistor circuit in the central unit, the input signal can be measured using ammeter (current) or voltmeter (voltage). The input signal operating window is 4 to 20mA, measured in series at the analog input terminal OR 1.1 to 5.5V, measured in parallel between the analog input and ground (GND) terminals. At 4mA the voltage is 1.1V and at 20mA the voltage is 5.5V. When troubleshooting this system, a current or voltage needs to be measured to determine the status or condition of the sensor.

Measuring current:

The ammeter (A) is used to measure current at the length input signal. Remove the wire from X1:27 terminal in the central unit and measure the current with the ammeter in series. The measurement should be between 4..20mA.

Measuring voltage:

The voltmeter (V) is used to measure voltage between pins X1:27 (length signal) and X1:28 (gnd) on the main board (024-352-300-001 / 9333103287). The resistors are there to show that at 4mA the voltage is 1.1V because current multiplied with resistance equals voltage; therefore, 4mA x 275 ohms (total resistance) = 1.1V.



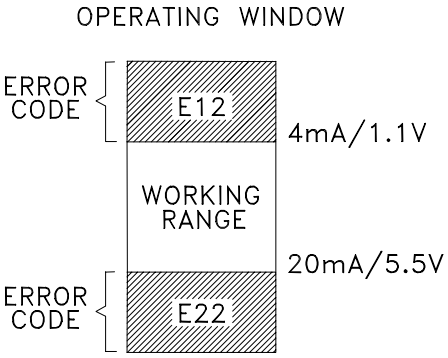
6.2 THEORY 2. OPERATION OF PISTON SIDE LOAD SENSOR

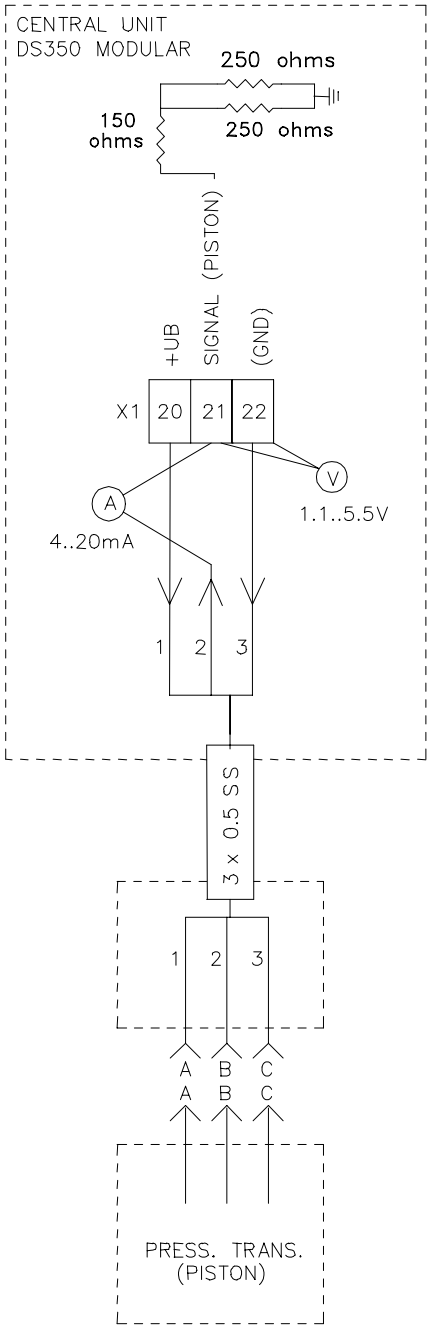
Measuring current:

The ammeter (A) is used to measure current at the piston side input signal. Remove the wire from X1:21 terminal in the central unit and measure the current with the ammeter in series. The measurement should be between 4..20mA.

Measuring voltage:

The voltmeter (V) is used to measure voltage between pins X1:21 (piston side signal) and X1:22 (gnd) on the main board (024-352-300-001. The resistors are there to show that at 4mA the voltage is 1.1V because current multiplied with resistance equals voltage; therefore, 4mA x 275 ohms (total resistance) = 1.1V.





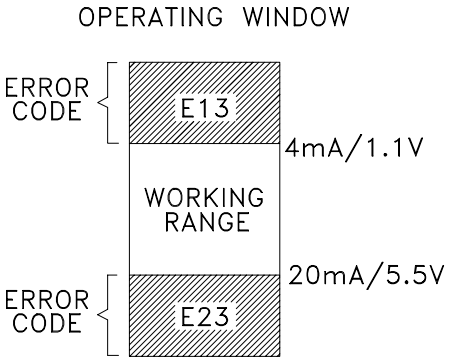
6.3 THEORY 3. OPERATION OF ROD SIDE LOAD SENSOR

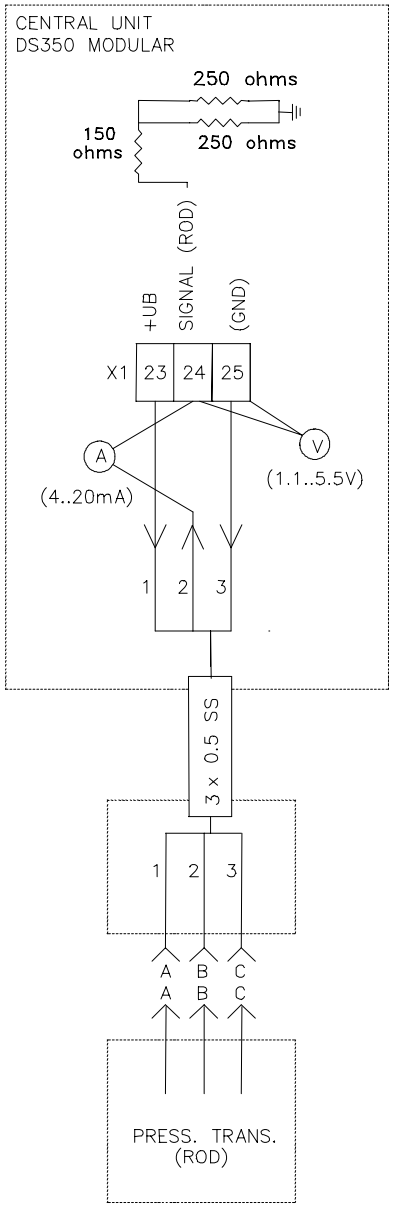
Measuring current:

The ammeter (A) is used to measure current at the rod side input signal. Remove the wire from X1:24 terminal in the central unit and measure the current with the ammeter in series. The measurement should be between 4..20mA.

Measuring voltage:

The voltmeter (V) is used to measure voltage between pins X1:24 (rod side signal) and X1:25 (gnd) on the main board (024-352-300-001). The resistors are there to show that at 4mA the voltage is 1.1V because current multiplied with resistance equals voltage; therefore, 4mA x 275 ohms (total resistance) = 1.1V.





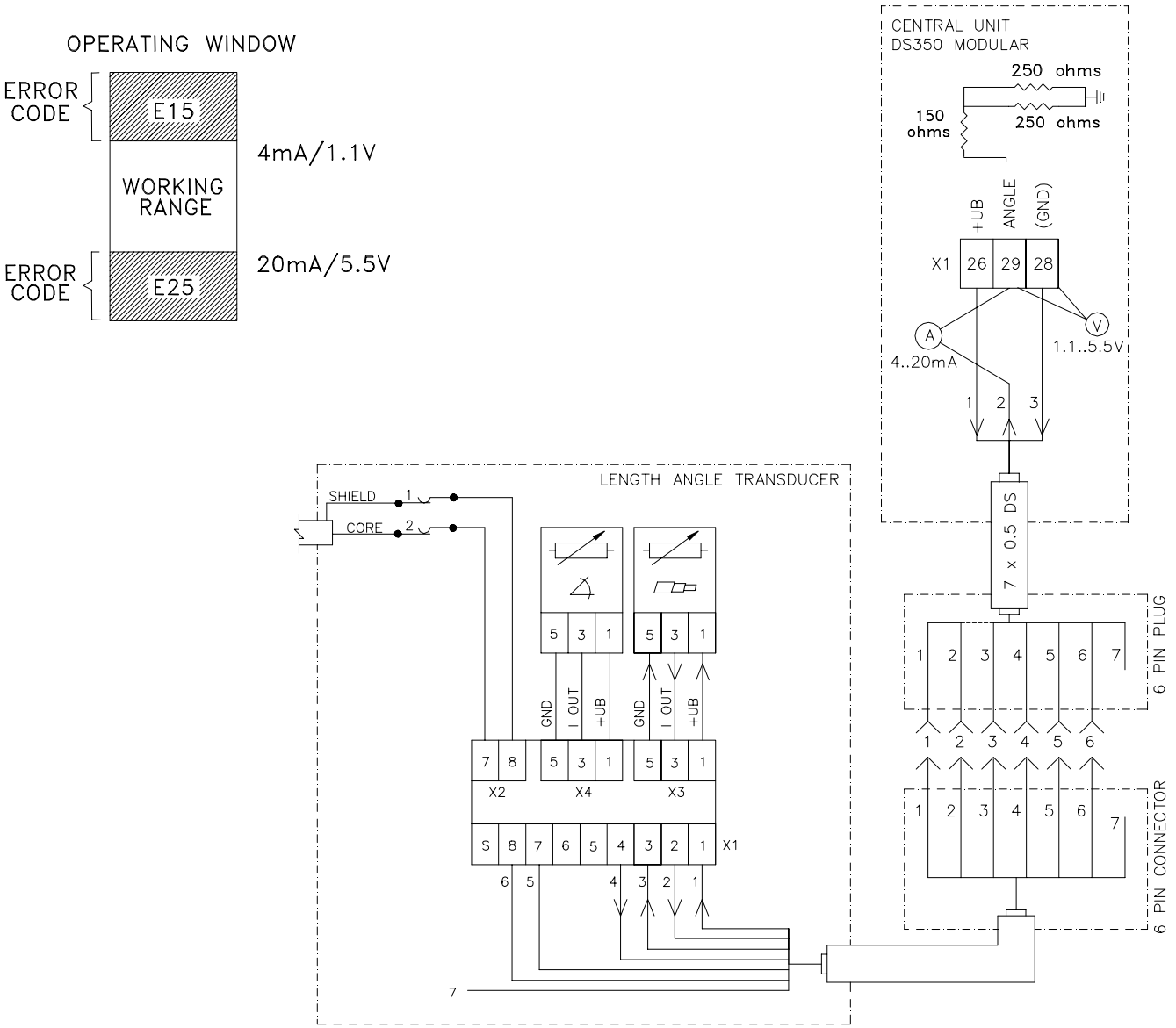
6.4 THEORY 4. OPERATION OF ANGLE SENSOR

Measuring current:

The ammeter Ⓐ is used to measure current at the angle input signal. Remove the wire from X1:29 terminal in the central unit and measure the current with the ammeter in series. The measurement should be between 4..20mA.

Measuring voltage:

The voltmeter is Ⓥ used to measure voltage between pins X1:29 (angle signal) and X1:28 (gnd) on the main board (024-352-300-001). The resistors are there to show that at 4mA the voltage is 1.1V because current multiplied with resistance equals voltage; therefore, 4mA x 275 ohms (total resistance) = 1.1V.



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